CHAPTER 78

EXHAUST

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This Table of Contents lists subjects contained in the Qantas 707-138 Maintenance Manual. Where these subjects conflict with those contained in Boeing 707 Stratoliner Maintenance Manual (Document D6-4004), the Company Manual will take precedence. Holders of Manuals when in receipt of Qantas Maintenance Manual revisions must revise the Table of Contents contained in the applicable chapter of both the Manuals.

CHAPTER 78

EXHAUST

TABLE OF CONTENTS

CHAPTER 78

EXHAUST

ALPHABETICAL INDEX

[1] AA 707-123 and QANTAS 707-138
[2] AA 707-123B and QANTAS 707-138B

EXHAUST SYSTEM - DESCRIPTION AND OPERATION

1. General

A. There are two different exhaust systems used on AA and QANTAS airplanes. The exhaust system on the engines of AA 707-123 airplanes and QANTAS model 707-138 airplanes consists of the thrust reverser - sound suppressor assembly, thrust reverser control system, thrust reverser position indicating system, and the exhaust plug (tailcone). The exhaust system used on the engines (turbofan) of AA 707-123B airplanes and QANTAS 707-138B airplanes consists of the forward thrust reverser, the aft thrust reverser including the tailpipe, the thrust reverser control system, thrust reverser position indicating system and the exhaust plug (tailcone).

THRUST REVERSER - SOUND SUPPRESSOR - DESCRIPTION AND OPERATION

1. General

A. The thrust reverser-sound suppressor assembly (figure 1) is used to reduce the length of the landing roll and to attenuate engine noise. During forward thrust operation, the thrust reverser serves as a tailpipe to allow exhaust gas flow to the sound suppressor with a minimum of power loss. During reverse thrust operation, the exhaust gasses are diverted through the side cascade vane assemblies in the thrust reverser, and the sound suppressor is not utilized. The thrust reverser attenuates engine noise during reverse thrust operation. The exhaust plug (tailcone) mounted to the engine plug support is independent of the thrust reverser-sound suppressor.

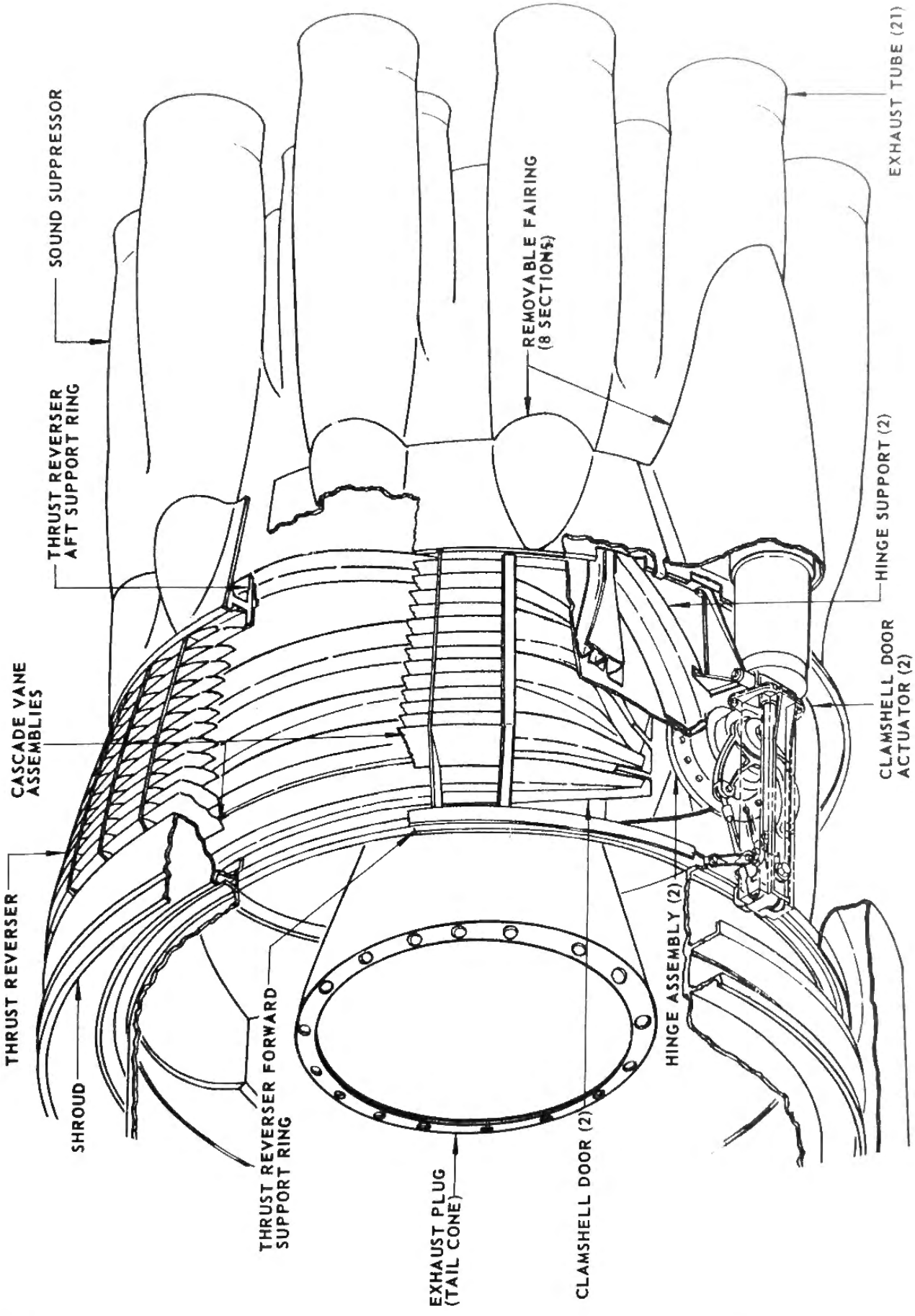
2. Sound Suppressor

A. The sound suppressor attenuates engine noise by dividing the exhaust blast into smaller flows and passing them through individual exhaust outlets. The sound suppressor consists of a main pressure vessel with 20 exhaust tubes. All of the exhaust tubes are re-enforced where they join the pressure vessel to retard crack propagation. The entire sound suppressor is assembled by the inert tungsten welding process and is bolted onto the rear of the thrust reverser.

3. Thrust Reverser

A. Each thrust reverser operates independently and consists of the main ring and deflector assembly, 18 vane assemblies, two clamshell doors, and two door hinge assemblies. The thrust reverser installations are identical for each engine except for the cascade vane assemblies. The deflectors for the center three vane assemblies on each side of each engine are oriented at different angles in order to prevent exhaust gas ingestion by the adjoining engine. Seals are installed on the aft clamshell door edges, the door hinges, and the forward thrust reverser support ring to minimize exhaust gas leakage during forward thrust operation.

B. Each thrust reverser assembly is installed on the rear of the engine and is pneumatically operated by bleed air from the high pressure compressor section (P_{t4}). The thrust reverser control system operates the door actuators which open and close the clamshell doors. For reverse thrust operation, the doors move aft and toward the engine centerline to the closed position. For forward thrust operation, the doors move forward to the open position. A reverser warning light for each thrust reverser is located on the engine instrument panel to provide indication of the clamshell door position.



Thrust Reverser and Sound Suppressor Assembly
Figure 1

SOUND SUPPRESSOR - MAINTENANCE PRACTICES

1. Removal/Installation Sound Suppressor

A. General

(1) The sound suppressor may be removed separately or with the thrust reverser.

B. Equipment and Materials

(1) Anti-Seize Compound - FEL-PRO C-5 or equivalent (Felt Products Mfg. Co., Chicago 7, Illinois)

C. Remove Sound Suppressor

(1) Remove nacelle aft fairing. See Access Doors and Panels, Chapter 12.

(a) Remove fairing 759 on outboard engines.

(b) Remove fairing 712 on inboard engines.

(2) Remove engine nacelle strut auxiliary fairings.

(a) Remove fairing 761 on outboard engines.

(b) Remove fairing 727 on inboard engines.

(3) Remove two fairings covering exhaust tubes on both sides of sound suppressor.

(4) Remove keel fairing covering lower exhaust tube.

(5) Remove bolts in thrust reverser aft support ring holding sound suppressor to thrust reverser. (See figure 201.) Remove upper bolts last and lift sound suppressor away from thrust reverser.

D. Install Sound Suppressor

(1) Coat threaded surfaces and shank to head of all bolts and screws with anti-seize compound prior to installation.

(2) Position sound suppressor to thrust reverser aft support ring and install bolts. (See figure 201.)

(3) Install keel fairing covering lower exhaust tube.

(4) Install two fairings covering exhaust tubes on both sides of sound suppressor.

(5) Install nacelle auxiliary fairings.

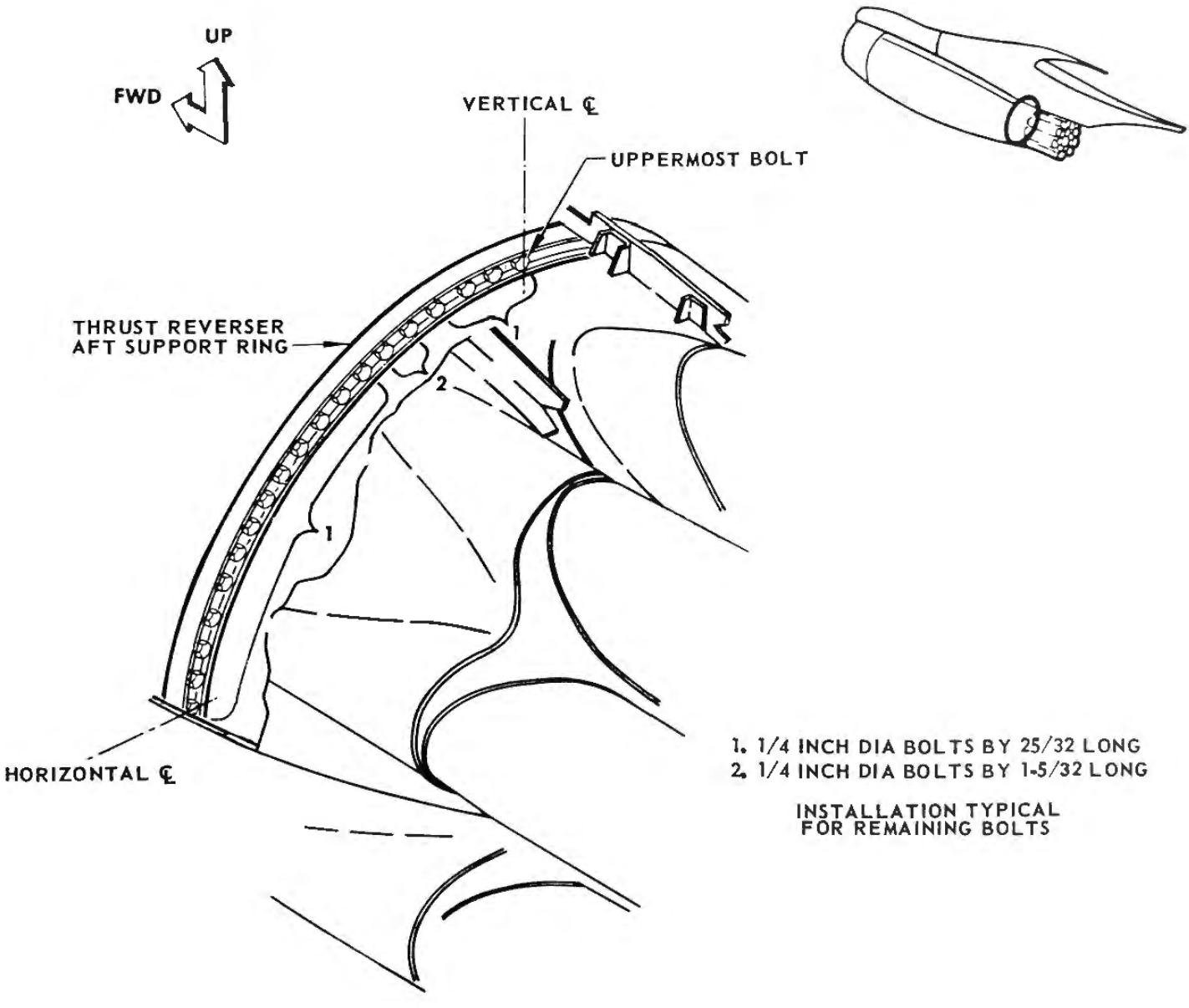
(a) Install fairing 761 on outboard engines

(b) Install fairing 727 on inboard engines

(6) Install nacelle aft fairing.

(a) Install fairing 759 on outboard engines

(b) Install fairing 712 on inboard engines



Sound Suppressor Installation
Figure 201

2. Inspection/Check Sound Suppressor

A. General

(1) Inspection of the sound suppressor consists mainly of examining the exhaust tube ends, tube collars, and pressure vessel for cracks which may require repair.

B. Examine Exhaust Tubes (See figures 202 and 203.)

(1) Examine ends of exhaust tubes for cracks.

(a) Cracks in the ends of the exhaust tubes may be allowed to progress straight forward to a maximum length of 1-1/4 inches, or until they turn and start to progress circumferentially around the tube or as shown in figure 202.

(2) Check for any other damage to exhaust tubes. Repair data and limits for severely damaged exhaust tubes are given in figure 203.

C. Examine Pressure Vessel and Tube Collars (See figure 202.)

(1) Examine pressure vessel and tube collars for cracks.

3. Approved Repairs Sound Suppressor

A. General

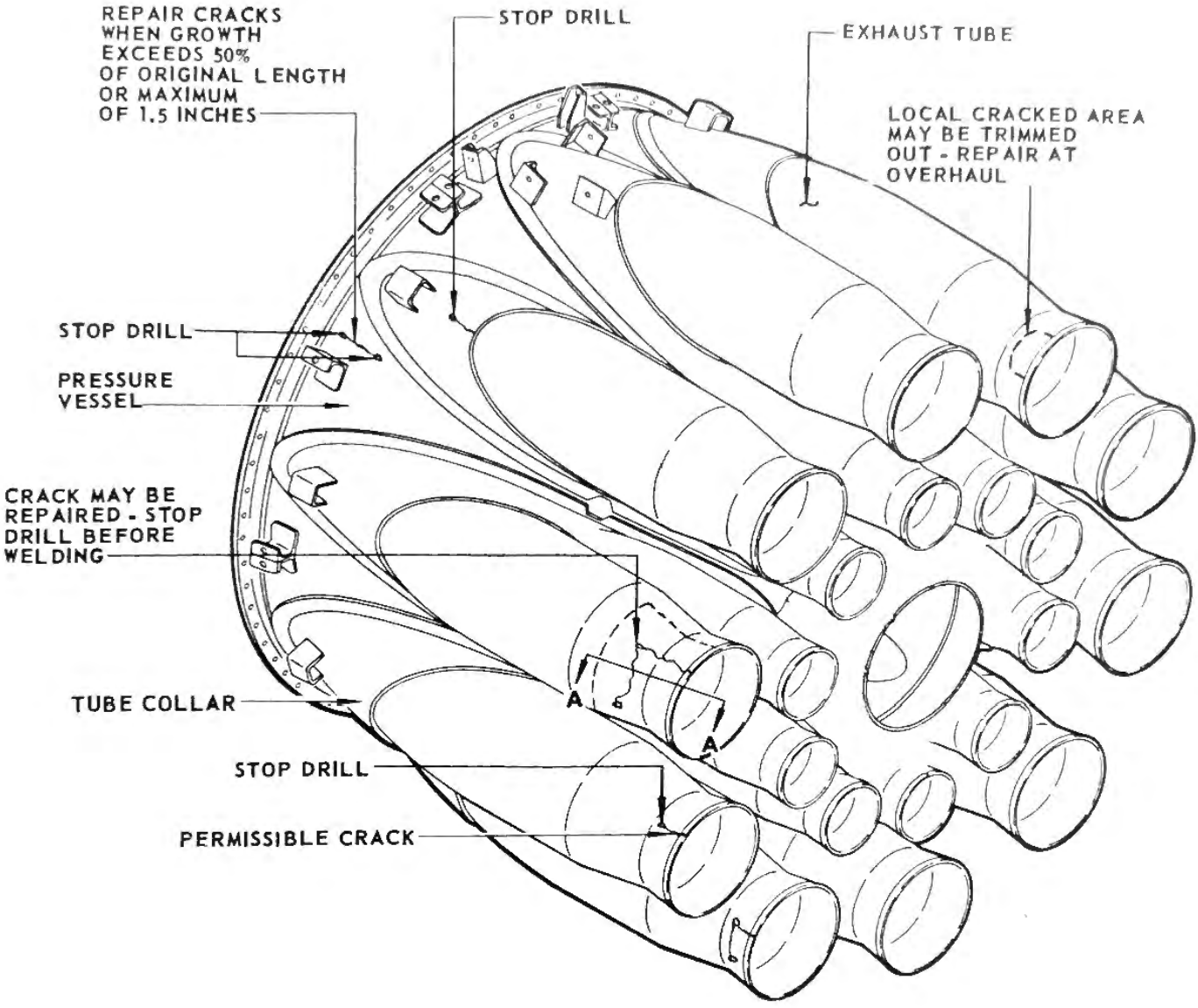
(1) Cracks in the exhaust tubes are not serious unless they progress. Repair is accomplished by stop-drilling and welding.

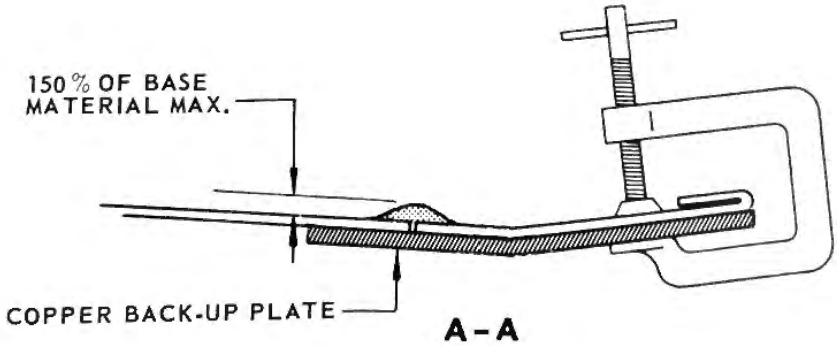
(2) Cracks in the tube collars and pressure vessel should be repaired when limits given in figure 202 are exceeded.

(3) Parts must not be pickled before welding. As a class, stainless steels are sensitive to hydrogen. The alloy used in the sound suppressor is subject to embrittlement if exposed to a rich source of hydrogen. Such a source would be provided by the acids used in a pickling solution. Before welding, parts should be degreased by any of the liquid or vapor methods employed for other aircraft parts.

(4) Cracks or other damage to the narrow band of material folded over the end of suppressor tubes is of no importance. The ends of the tubes are doubled primarily to provide rigidity that will prevent distortion of the tubes by careless handling. Also considered unimportant is out-of-roundness. This condition has no effect on suppressor efficiency and no repair is required.

(5) Severely damaged or broken off tubes must be replaced or trimmed.





A-A

Sound Suppressor Typical Crack Areas and Repair Data
Figure 202

B. Equipment and Materials

(1) Inert tungsten arc welding equipment

(2) Bare filler wire - 347, 19-9WX, or equivalent

C. Repair Exhaust Tubes (See figures 202 and 203.)

(1) Stop drill all cracks. If stop-drilling does not stop crack, plug weld stop-drill holes and fusion weld crack between plug welds or trim out local cracked area per figure 203. Use inert tungsten arc welding with AISI 347 or 19-9WX bare filler wire.

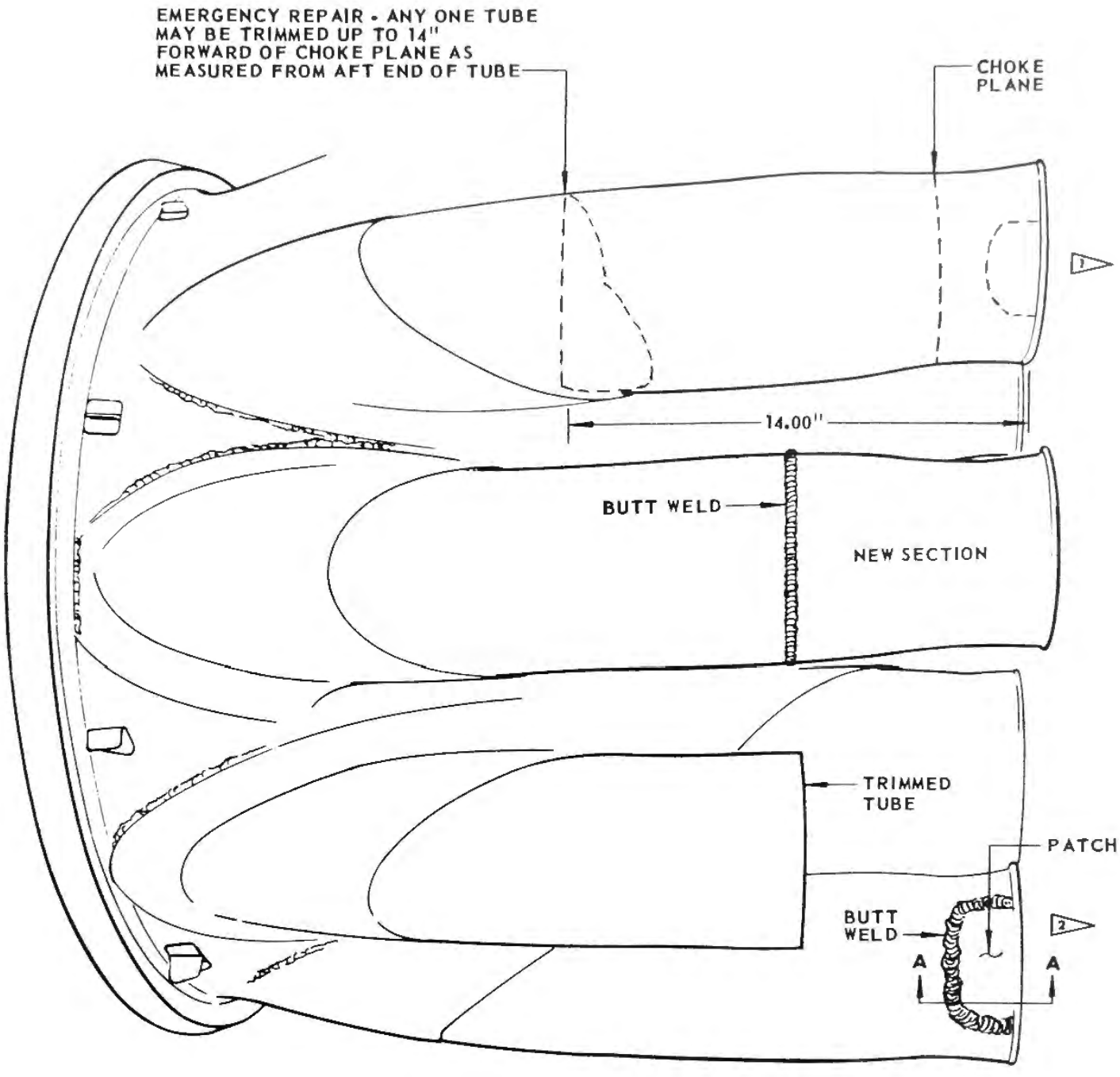
CAUTION: REPAIR WELD AREA SHOULD BE CLEAN AND WELD BEAD SIZE SHOULD NOT BE GREATER THAN 150 PER CENT OF THE BASE MATERIAL THICKNESS. FURTHER CRACKING CAN RESULT IF REPAIR WELD AREAS ARE NOT CLEAN OR IF WELD BEADS ARE TOO HEAVY.

NOTE: A 1/4-inch copper back-up plate should be used to prevent excessive weld burn-through and oxidation. If a copper back-up plate is not available, the reverse side of the crack area should be painted with flux, Ryco No. 70, or equivalent. Remove flux residue after welding.

The use of a copper back-up plate will assure initial alignment of crack edges; however, during welding, warpage will occur. To avert misalignment, the crack should be tack welded. Tacks should be spaced approximately 3/4 inch apart. All tack welds should be held to the smallest size possible so as not to interfere with the final welding operation.

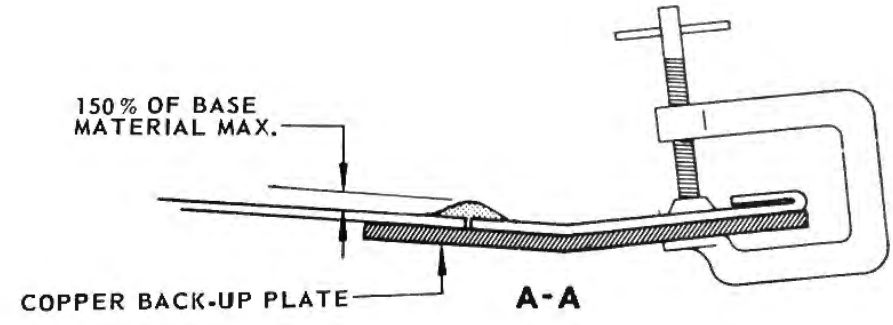
(2) If a tube is severely damaged in handling or if a portion cracks completely off in service, the damage may be repaired by trimming damaged tube and butt fusion welding a new section or patch as shown in figure 203. Grind weld bead after welding if bead exceeds 150% of base metal thickness. Use inert tungsten arc welding with AISI 347 or 19-9WX bare filler wire.

(3) As an emergency measure a sound suppressor with severely damaged tubes may be repaired according to the following limitations.



1 LOCAL CRACKED AREA MAY BE TRIMMED OUT - REPAIR AT OVERHAUL

2 PATCH MAY BE BUTT WELDED INTO TRIMMED OPENING WHERE PORTION OF TUBE END IS MISSING



Repair of Severely Damaged Exhaust Tubes
Figure 203

(a) Any two tubes may be cut off forward of the choke plane up to a maximum of 11.00 inches as measured from the aft end of the tube. Make cuts parallel to aft end.

(b) Any one tube may be cut off forward of the choke plane up to 14.00 inches as measured from the aft end of the tube. Make cuts parallel to aft end but do not cut collar. Cut on a bias next to collar back to the 14.00 inch line.

(c) Where cracks extend less than 2.00 inches beyond 14.00 inch line and not into collar, operation with cut-off at 14.00 inches is permissible on basis that progression improbable with overhanging mass of tube removed. Stop drill such cracks.

(4) Scratches, nicks, and corrosion penetrating to 20% of the material thickness are allowable. Polish out such damage to original finish.

D. Repair Pressure Vessel and Tube Collars (See figure 202.)

(1) Repair all cracks in the pressure vessel or in the tube collar when limits given in figure 202 are exceeded. Use inert tungsten arc welding and AISI 347 or 19-9WX bare filler wire.

(2) Scratches, nicks, and corrosion penetrating to 20% of the material thickness are allowable. Polish out such damage to original finish.

END

THRUST REVERSER - MAINTENANCE PRACTICES

1. Removal/Installation Thrust Reverser

A. General

(1) The thrust reverser may be removed with the sound suppressor attached.

B. Equipment and Materials

(1) Hoist Assembly - F70014 or equivalent

(2) Sound Suppressor and Thrust Reverser Adaptor - F70051 or equivalent

(3) Air pressure source - 0 to 200 psig capacity

(4) Spring scale - 0 to 30 pounds capacity

(5) Anti-Seize compound - FEL-PRO C-5 or equivalent (Felt Products Mfg. Co., Chicago 7, Illinois)

C. Remove Thrust Reverser

(1) Remove nacelle cowl panels.

(2) Remove nacelle aft fairing. See Access Doors and Panels, Chapter 12.

(a) Remove fairing 759 on outboard engines.

(b) Remove fairing 712 on inboard engines.

(3) Remove nacelle auxiliary fairings.

(a) Remove fairing 761 on outboard engines.

(b) Remove fairing 727 on inboard engines.

(4) Remove thrust reverser top fairings.

(5) Remove thrust reverser keel fairing.

(6) Position hoist assembly with sound suppressor and thrust reverser adapter under thrust reverser.

(7) Remove exhaust shroud at thrust reverser forward support ring.

(8) Remove EGT harness located on heat shield forward of thrust reverser attachment bolts.

NOTE: On airplanes not having heat shield remove clamps on EGT harness and shift harness forward to gain access to thrust reverser installation bolts.

(9) Remove heat shield.

(10) Disconnect pneumatic tubing from both door actuators at thrust reverser forward support ring.

(11) Disconnect follow-up control crank from upper door actuator guide track. (See figures 201 and 202.)

(12) Disconnect wiring from terminals of thrust reverser warning light switch.

(13) Remove cascade vane assemblies.

(a) Remove bolts holding vane assemblies to thrust reverser forward support ring.

(b) Remove assemblies by lifting out and forward from thrust reverser.

(14) Remove remaining bolts in forward support ring.

CAUTION: CHECK THAT HOIST ASSEMBLY AND ADAPTER HAVE ASSUMED THRUST REVERSER LOAD BEFORE REMOVING REMAINING BOLTS.

(15) Remove thrust reverser from engine.

D. Install Thrust Reverser

(1) Coat threaded surfaces and shank to head of all bolts and screws with anti-seize compound prior to installation.

(2) Position thrust reverser on rear of engine.

(3) Attach thrust reverser to engine by installing bolts.

(a) Install a 5/16 in. dia. by 31/32 long bolt in uppermost hole in thrust reverser forward support ring.

(b) Install a 5/16 in. dia. by 31/32 long bolt in lowermost hole in thrust reverser forward support ring.

(c) Install 5/16 in. dia. by 31/32 long bolts in first 8 holes on each side of uppermost and lowermost bolts.

(4) Position cascade vane assemblies on thrust reverser and attach with 5/16 in. dia. by 1-3/32 long bolts. Install as shown in 78-2-31, figure 201.

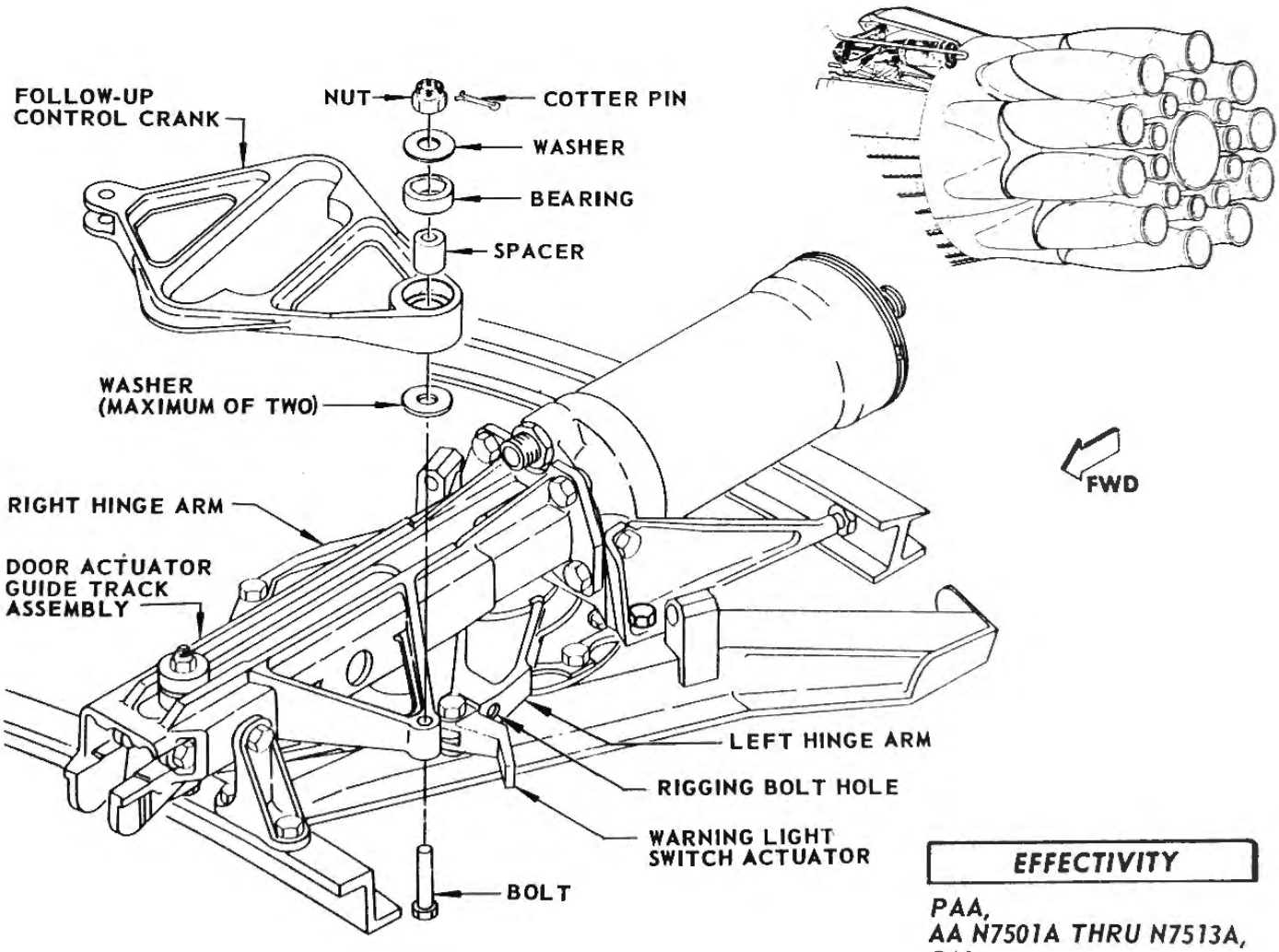
(5) (PAA, AA N7501A thru N7513A, CAL, TWA N731TW thru N739TW, and QANTAS VH-EBA) Install follow-up crank on upper door actuator guide track assembly. (See figure 201.)

(a) Position bolt through guide track assembly.

(b) Position thin washer over bolt. Use washers as required to maintain clearance of 0.01 (+0.03/-0.00) inch between upper face of guide track and lower face of follow-up control crank. Two washers are maximum that should be used.

(c) Place follow-up control crank, staked bearing downward, on bolt. Position spacer and bearing on bolt.

(d) Install washer and nut on bolt. Torque nut at 160 to 190 pound-inches and install cotter pin.



EFFECTIVITY

PAA,
AA N7501A THRU N7513A,
CAL,
TWA N731TW THRU N739TW,
QANTAS VH-EBA

Door Actuator Follow-up Control Crank Installation
Figure 201

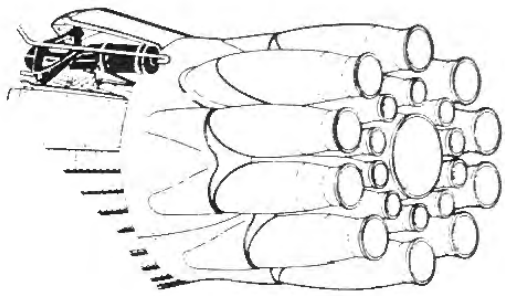
(6) (AA N7514A thru N7525A, TWA N740TW thru N745TW, QANTAS VH-EBB thru VH-EBG, and USAF) Install follow-up control crank on upper door actuator guide track assembly. (See figure 202.)

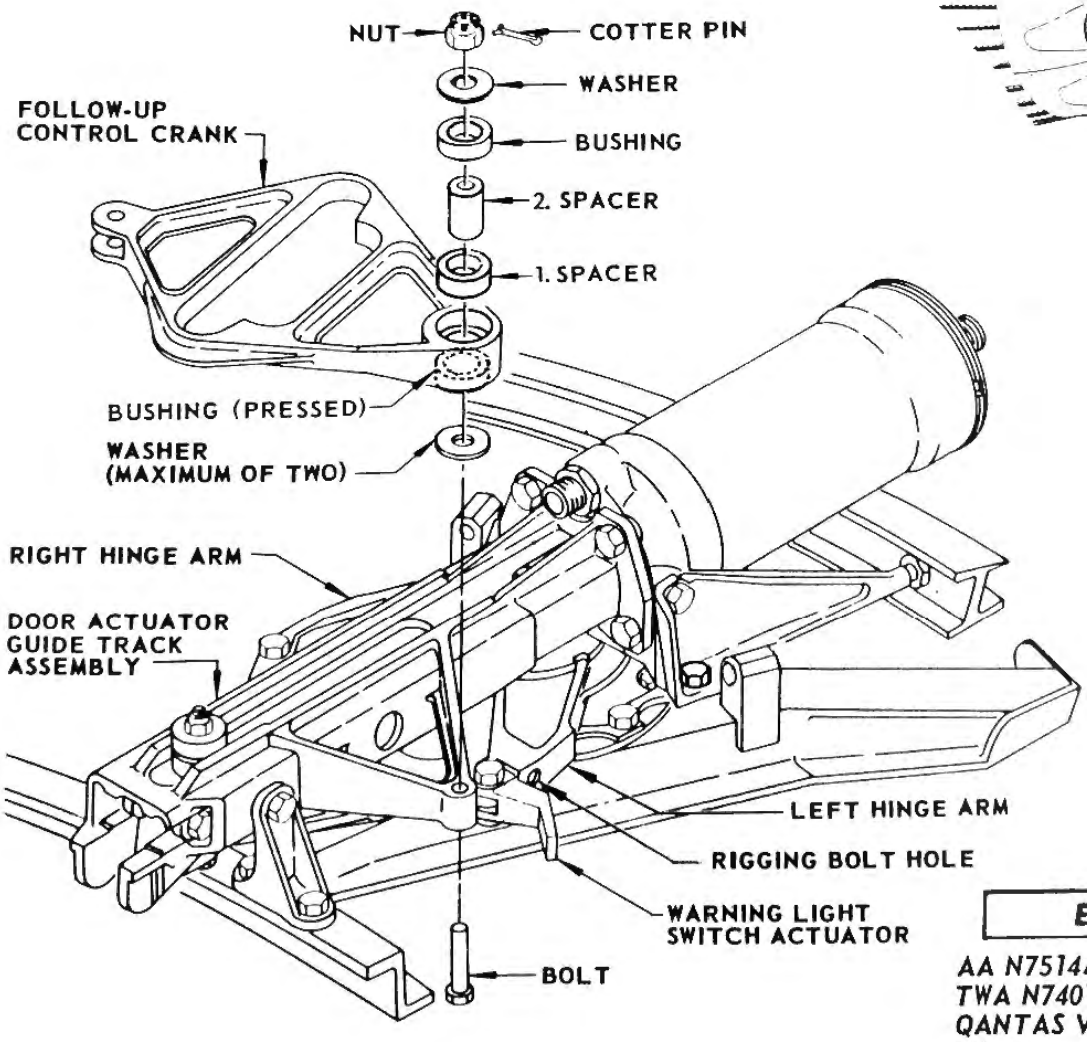
(a) Position bolt through guide track assembly.

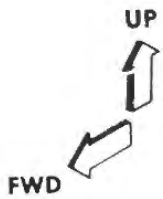
(b) Position thin washer over bolt. Use washers as required to maintain clearance of 0.01 (+0.03/-0.00) inch between upper face of guide track and lower face of follow-up control crank. Two washers are maximum that should be used.

(c) Install spacer (1) in follow-up control crank.

(d) Place follow-up control crank, pressed bushing downward, on bolt. Position spacer and bushing on bolt.







EFFECTIVITY

AA N7514A THRU N7525A, TWA N740TW THRU N745TW, QANTAS VH-EBB THRU VH-EBG, USAF

Door Actuator Follow-up Control Crank Installation
Figure 202

(e) Install washer and nut. Torque nut from 160 to 190 pound-inches. Maintain gap between washer and bushing at .02 ± .01 inches. Use AN960C816L washer or equivalent (.875 OD, .515 ID x .032 Thick) if necessary in order to maintain gap.

(7) With engine at ambient (atmospheric) temperature, rig lockout control to door actuator follow-up crank.

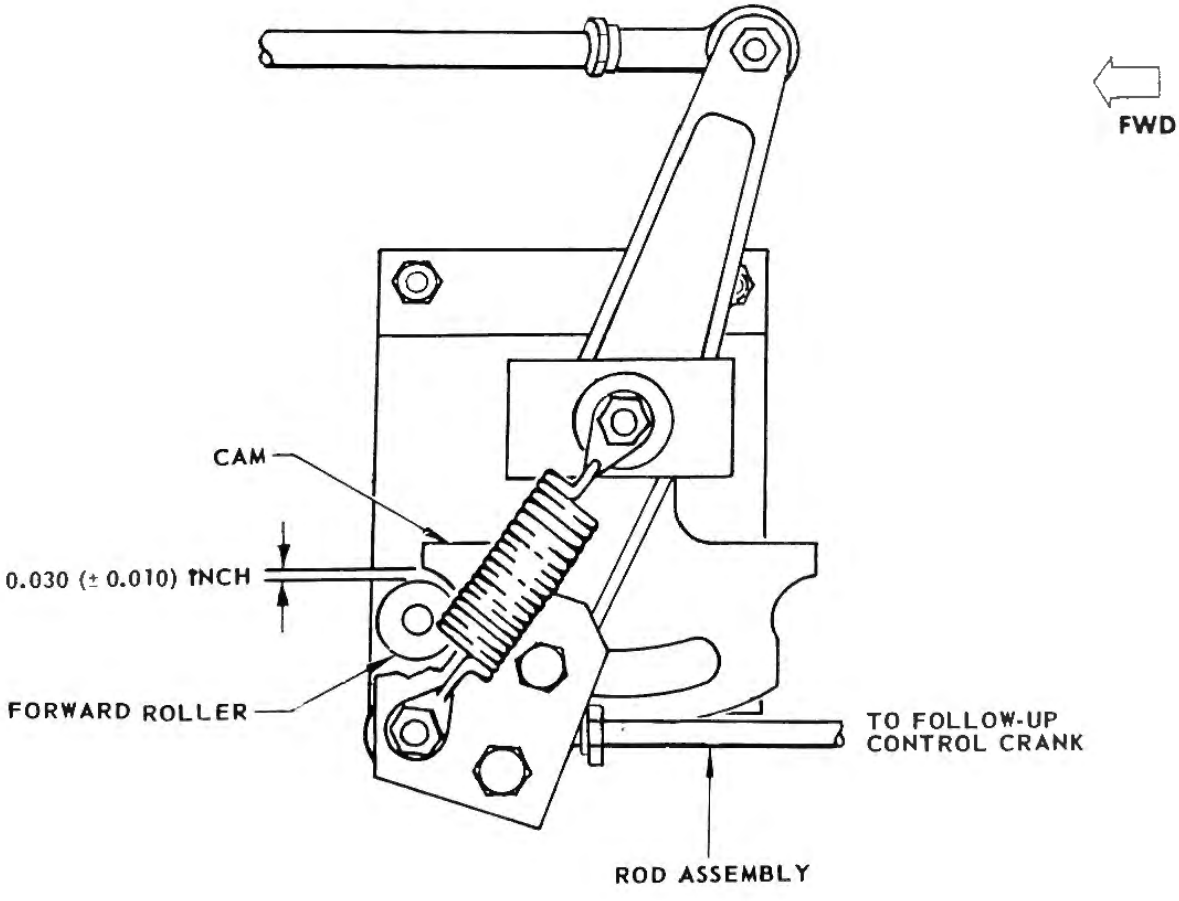
(a) Position clamshell doors in forward thrust position.

(b) Apply a 10 (+20/-5) pound load in aft direction at rod assembly between door actuator follow-up crank and lockout control. Apply load at follow-up crank end of rod. (See figure 203.)

(c) Adjust rod assembly to give a 0.03 (± 0.01) inch clearance between forward roller on lockout control and lockout control cam.

(d) Torque check nuts on rod assembly at 60 to 85 pound-inches.

(8) Disconnect hinge arm links from hinge arms and place clamshell doors in the forward thrust position. Hold with NAS 501 rigging bolt through hinge arms. (See figure 204.)



Lockout Control Rigging
Figure 203

(9) Apply an air source to actuator "HEAD" ports. Regulate to 25 psig to hold the pistons against the internal stops.

NOTE: Volume capacity of air source is important. Therefore, minimum ground air line size should be equivalent to normal thrust reverser pressure line. The gage should be located close to the ground connection shuttle valve.

(10) Adjust links to fit hinge arms and tighten check nuts.

(11) Connect links to hinge arms.

(a) Position links to hinge arms and install bolts with bolt shanks pointing toward thrust reverser.

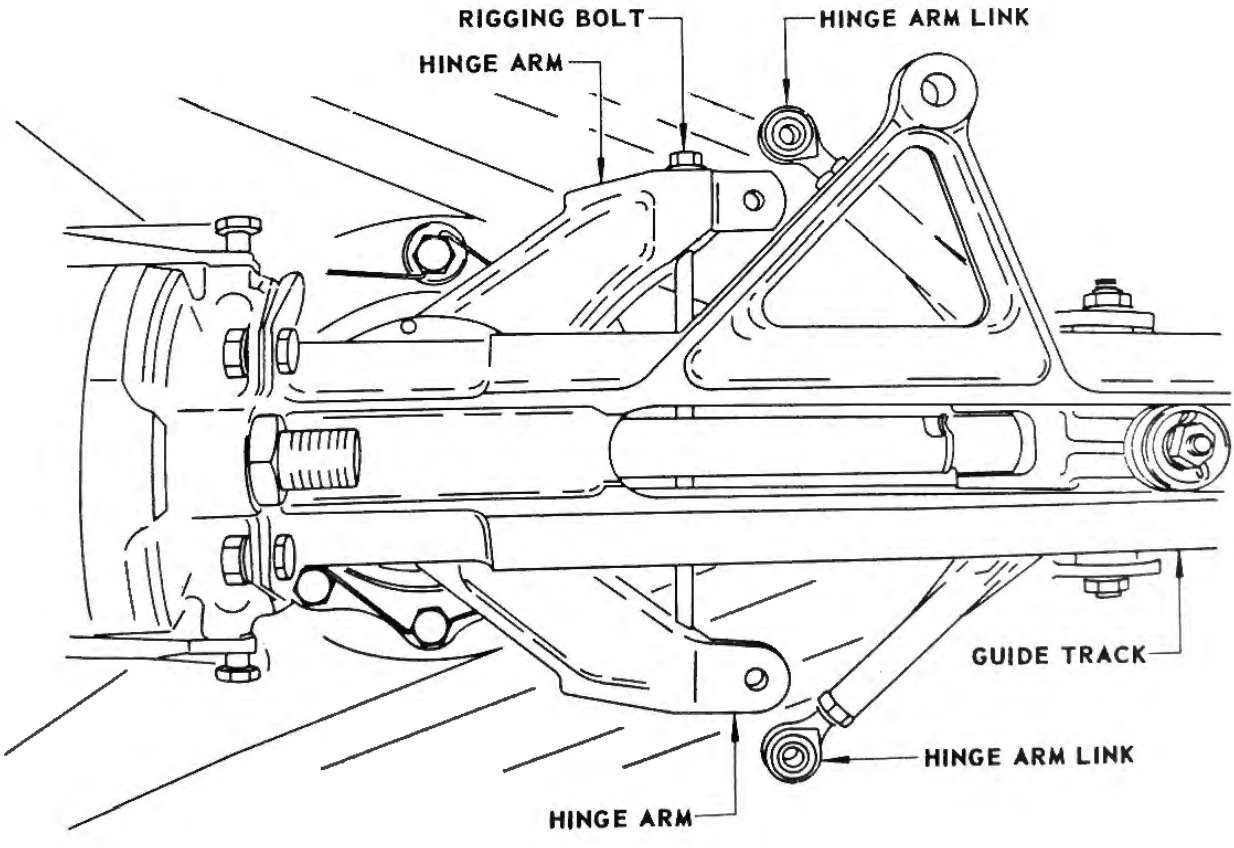
(b) Install washer, nut and cotter pin. Install warning light switch actuator on upper left hinge arm.

(c) Install cotter pin.

(12) Remove rigging bolt.

(13) Connect door actuator pneumatic tubing.

(14) Connect wiring to terminals of warning light switch.



Clamshell Door Rigging
Figure 204

(15) Install heat shield.

NOTE: Some airplanes do not have heat shield installation.

(16) Install EGT harness on heat shield.

NOTE: On airplanes not having heat shield reposition EGT harness aft and install clamps.

(17) Place forward and reverse thrust levers at idle.

(18) Apply electrical power to airplane.

(19) Check that reverser warning light remains off.

(20) Connect air source to ground air service connection and regulate to 25 psig. Check that all moisture is out of air hose before connecting to ground service connection.

(21) Move reverse thrust lever aft rapidly until limit stop is contacted. Check that clamshell doors move to reverse thrust position within two seconds time.

(22) Check that reverser warning light illuminates.

(23) Return reverse thrust lever to idle position.

(24) Check that clamshell doors are in forward thrust position and reverser warning light is off.

(25) Disconnect air source and remove electrical power from bus.

(26) Install exhaust shroud.

(27) Install nacelle aft fairings. See Access Doors and Panels, Chapter 12.

(a) Install fairing 759 on outboard engines.

(b) Install fairing 712 on inboard engines.

(28) Install nacelle auxiliary fairings.

(a) Install fairing 761 on outboard engines.

(b) Install fairing 727 on inboard engines.

(29) Install thrust reverser keel fairings.

(30) Install thrust reverser top fairings.

(31) Install nacelle cowl panels.

2. Adjustment/Test Thrust Reverser

A. Testing of the thrust reverser consists of checking clamshell door actuation, door seal contact, warning light operation and air leakage.

B. Equipment and Materials

(1) Air Pressure Source - 0 to 200 psig.

C. Test Thrust Reverser

(1) Manually cycle clamshell doors to verify the following:

(a) Clamshell door attachment bolts clear hinge bearing supports.

(b) All seals are contacting without jamming and resultant seal damage.

(2) Place forward and reverse thrust levers in their respective idle positions.

(3) Open left nacelle cowl panel.

(4) Connect air pressure source to ground air shuttle valve and regulate to 25 psig.

NOTE: Volume capacity of air source is important. Therefore, minimum ground air line size should be equivalent to normal thrust reverser pressure line. The gage should be located close to the ground connection shuttle valve.

(5) Check that clamshell doors remain in forward thrust position (open).

(6) Check that thrust reverser warning light remains out.

(7) Check that leading edges of clamshell doors seat behind interface of forward seal assembly by looking through rear of sound suppressor.

(8) Move reverse thrust lever to interlock position (approximately 60° lever movement to 15% thrust condition).

(9) Check that thrust reverser warning light illuminates as doors move from forward thrust position.

(10) Check that clamshell doors move to reverse thrust position within 2 seconds.

(11) Check that aft edges of clamshell doors close to within 3/8 inch.

(12) Return reverse thrust lever to idle position.

(13) Check that clamshell doors return to forward thrust position within 2 seconds.

(14) Regulate air pressure to 15 psig.

(15) Operate thrust reverser through one complete cycle. Doors shall operate at 15 psig minimum and cycle in a reasonable period of time.

(16) Regulate pressure source to 200 psig.

CAUTION: DO NOT CPERATE DOCRS AT THIS PRESSURE. EXCESSIVE DOOR VELCCITY CAN CAUSE DAMAGE TC DOOR TRAILING EDGE.

(17) Check tubing, flexible hose and fittings for leakage.

(18) Relieve air pressure.

(19) Remove air pressure source from ground air shuttle valve and recap valve.

(20) Close left nacelle cowl panel.

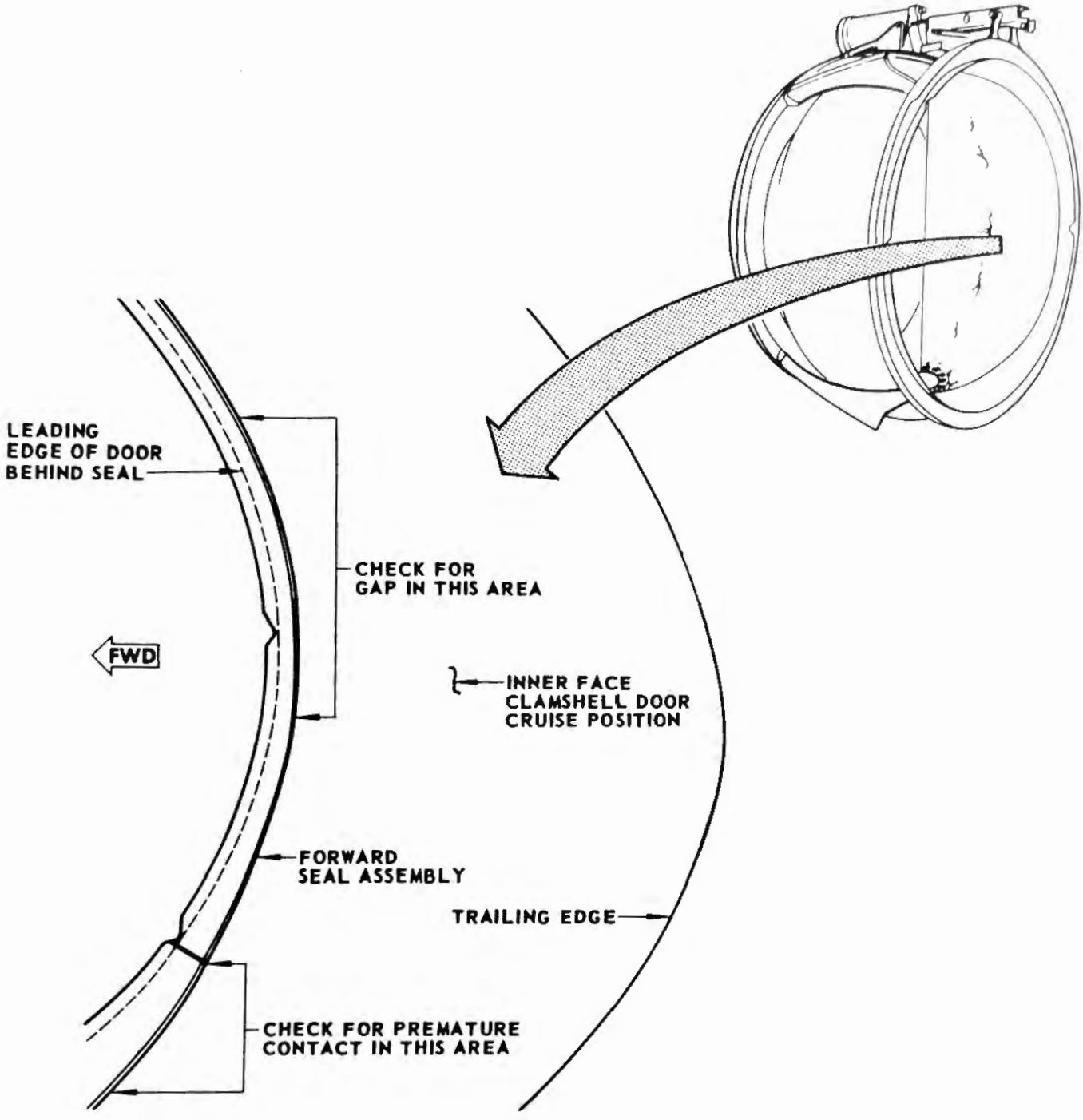
3. Inspection/Check Thrust Reverser

A. General

(1) Inspection of the thrust reverser consists mainly of the following: checking for cracks and wear of the thrust reverser components, checking for proper seal contact, checking for missing vanes in the cascade vane assemblies, and checking for missing seal leaves on the seal assemblies.

B. Check Clamshell Door - Forward Seal Contact

(1) With doors in cruise position check for at least a 75-percent contact with the forward seal. The fit of the door in the seal is affected by any deviation from the correct contour of the door leading edge. Figure 205 shows the proper relation between a door and the forward seal. Also shown are the areas where misfit can be detected. Changes in contour of the door leading edge will probably make the door contact the seal prematurely in the hub areas; this may produce an appreciable gap near the center portion of the door.

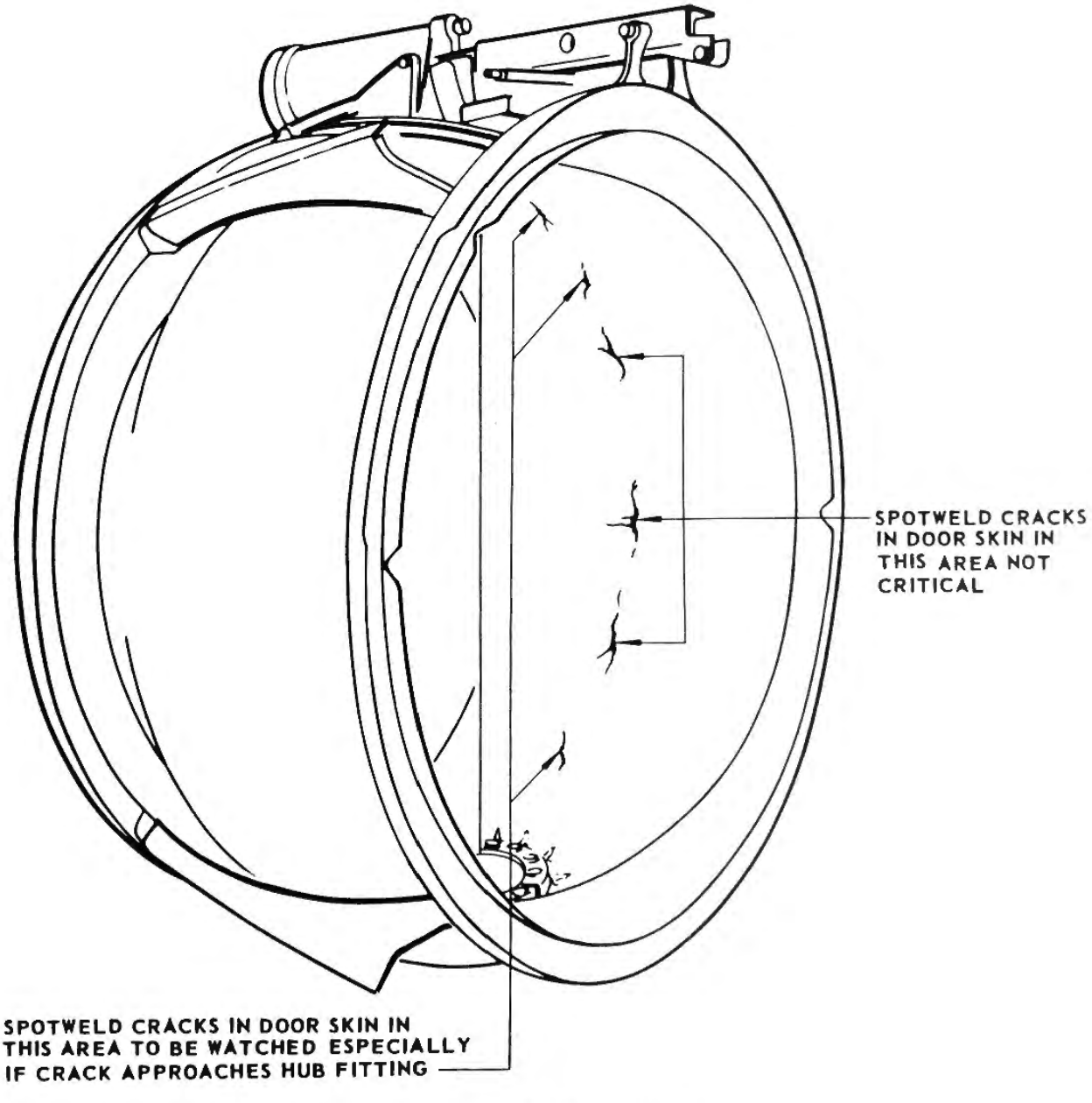


Clamshell Door and Forward Seal (Cruise Position)
Figure 205

C. Examine Clamshell Doors

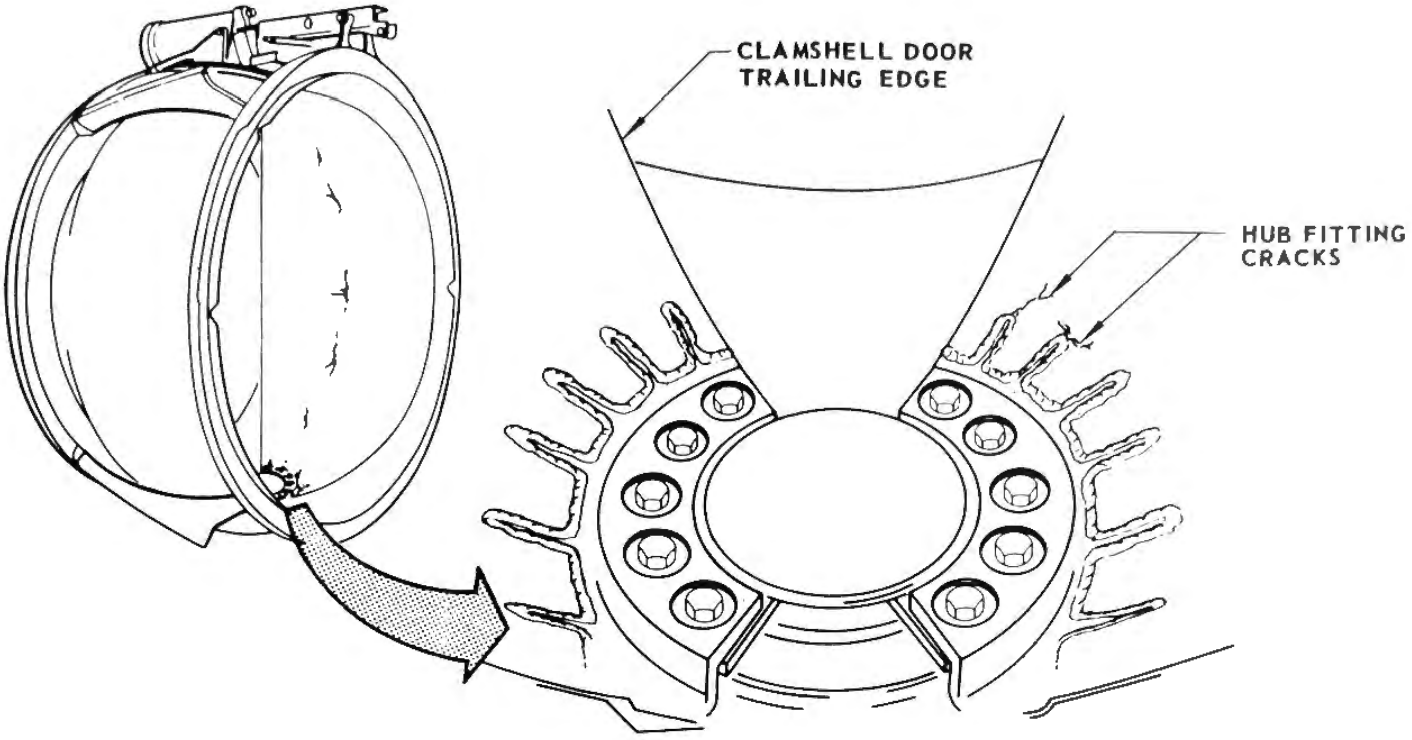
(1) Examine inner skin of clamshell door for spotweld cracks. These cracks result from differential expansion between inside and outside skin. Usually the cracks do not progress after the material has relieved itself. The recommended maintenance procedure is to keep cracks under surveillance. The need for repair depends on the location of cracks and their rate of increase. Figure 206 shows the area to be inspected for cracks.

NOTE: Differences in temperature between the door inner skin and the outer skin may also produce wrinkles. The structure of the door includes internal hat-section reinforcing to which the skins are spotwelded. Wrinkles may form between the rows of spotwelds. Such wrinkling is not detrimental to operation of thrust reverser; no repair or rework is required.



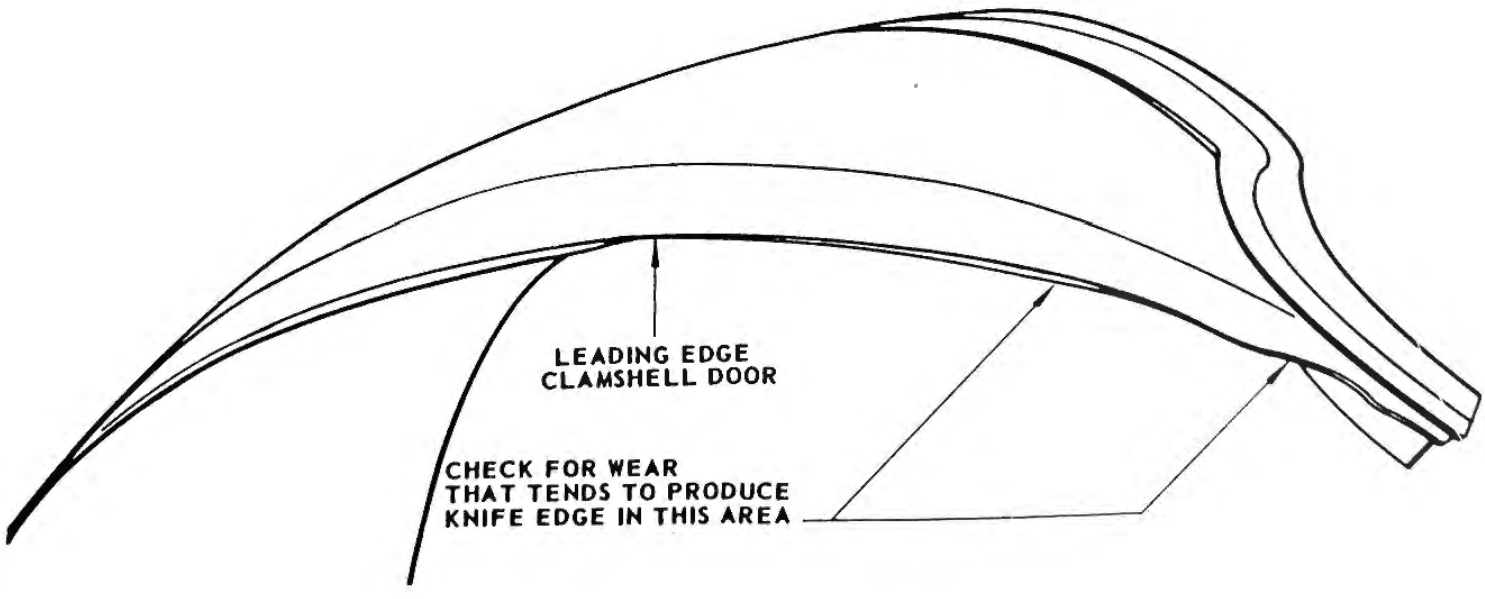
Typical Cracks - Clamshell Door
Figure 206

(2) Check for cracks near welding beads in the hub area. Such cracks can be expected to assume the appearance illustrated in Figure 207.



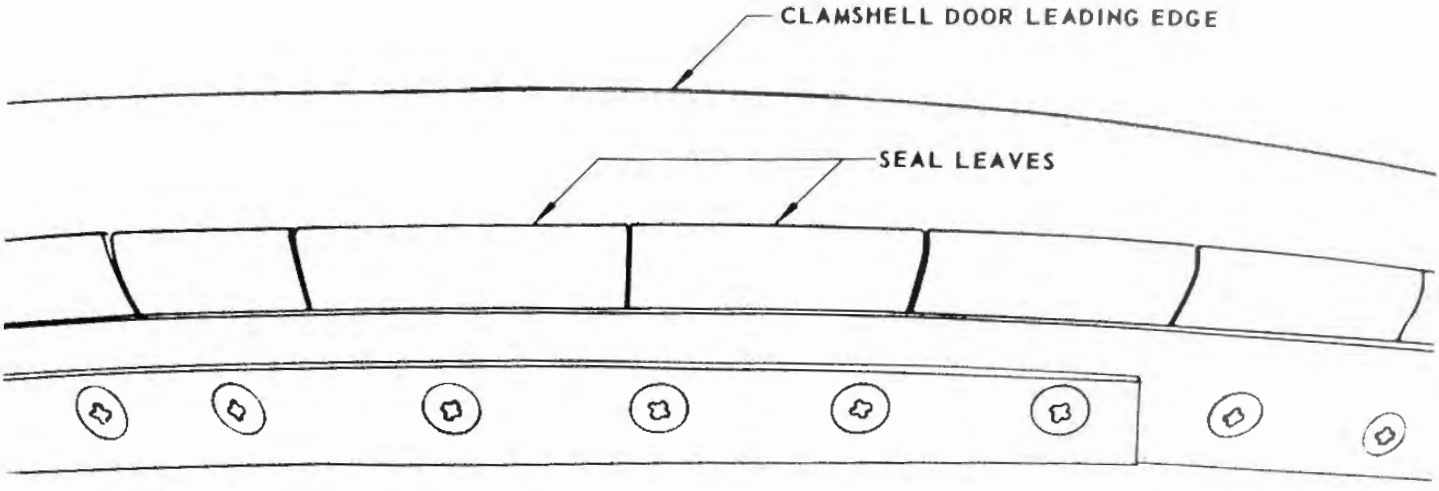
Clamshell Door Hub Crack Location
Figure 207

(3) Check for excessive wear of door leading edge. Such wear may produce a sharp edge in the area indicated in Figure 208.



Clamshell Door Leading Edge Wear Location
Figure 208

(4) Check for missing seal leaves on aft door seal; the seal is located on door trailing edge and contains an inner and an outer overlapping layer of seal leaves. (See figure 209.)

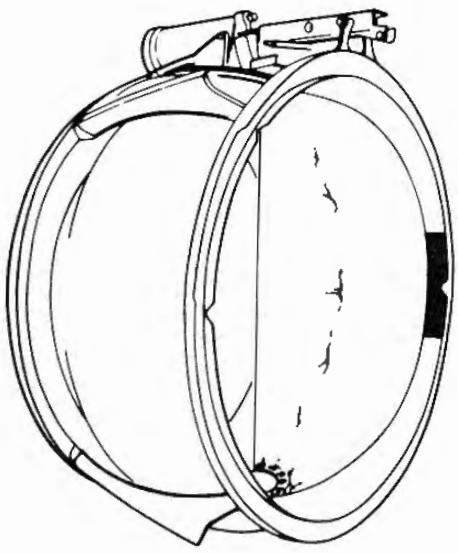


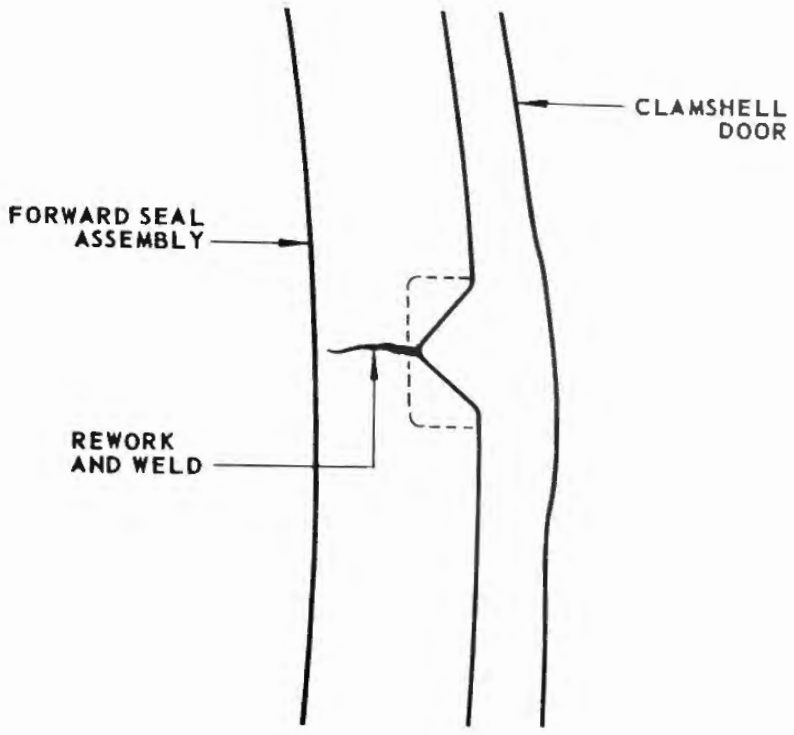
Clamshell Door Aft Seal Leaves
Figure 209

D. Examine Forward Seal Assembly

(1) Examine forward seal assembly for cracks.

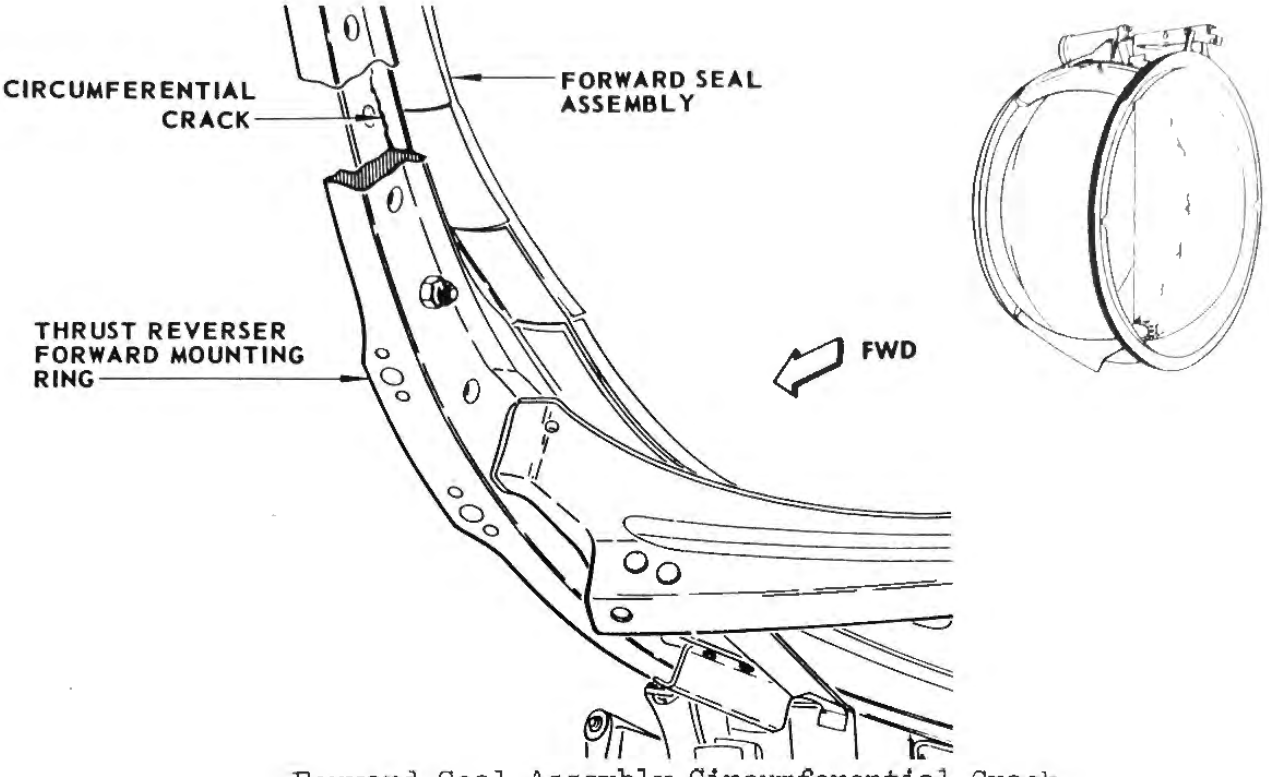
(a) Cracks in "V" notches are illustrated in figure 210.





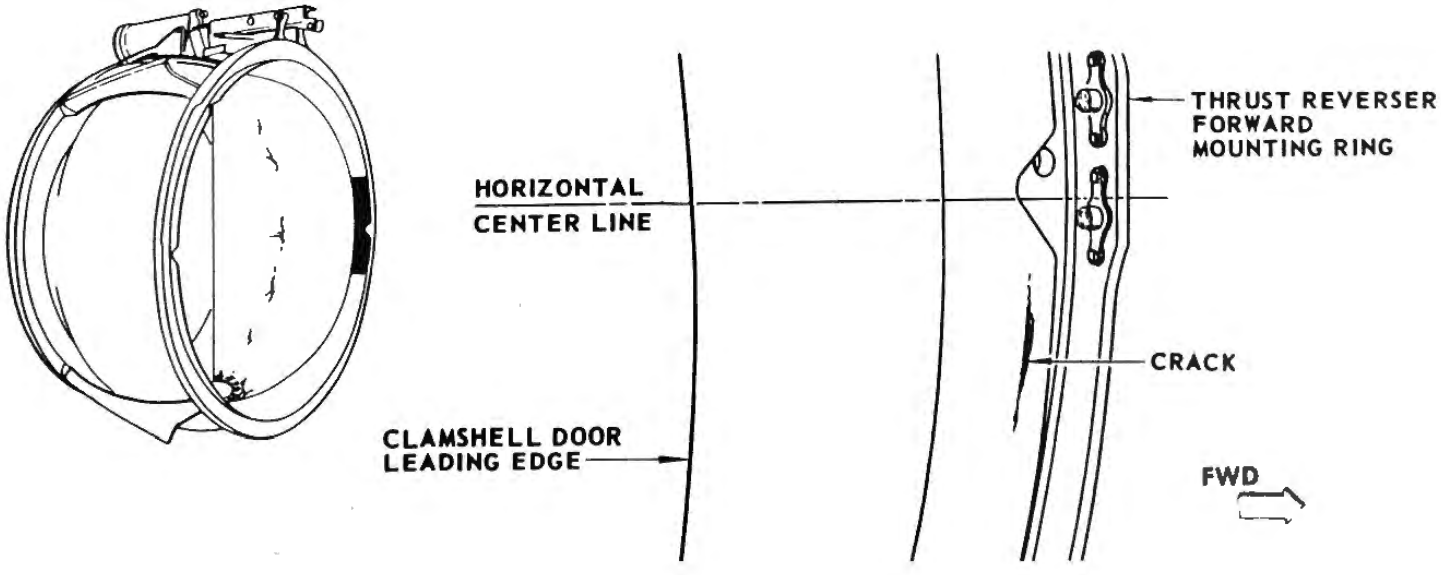
Typical V-Notch Crack - Forward Seal Assembly
Figure 210

(b) Figure 211 shows where circumferential cracks on front seal could cause separation of seal from contact with door (cruise position). Conceivably, an entire segment of seal could be lost from such a crack.



Forward Seal Assembly Circumferential Crack
Figure 211

(c) Figure 212 illustrates a crack possiblility on inner surface of forward seal assembly.

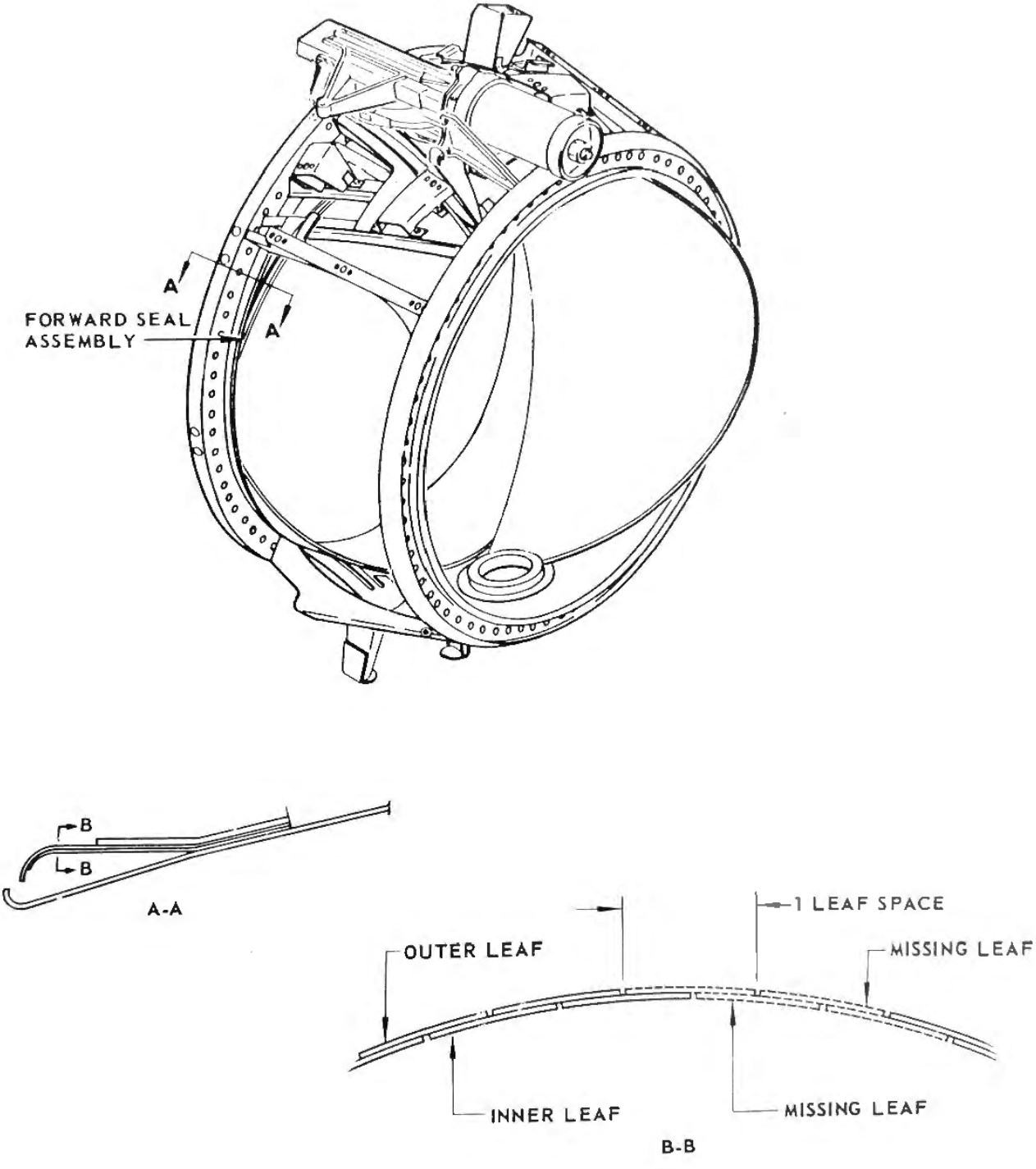


Typical Cracks - Forward Seal Assembly
Figure 212

(2) Examine forward seal assembly for missing seal leaves. (See figure 213.)

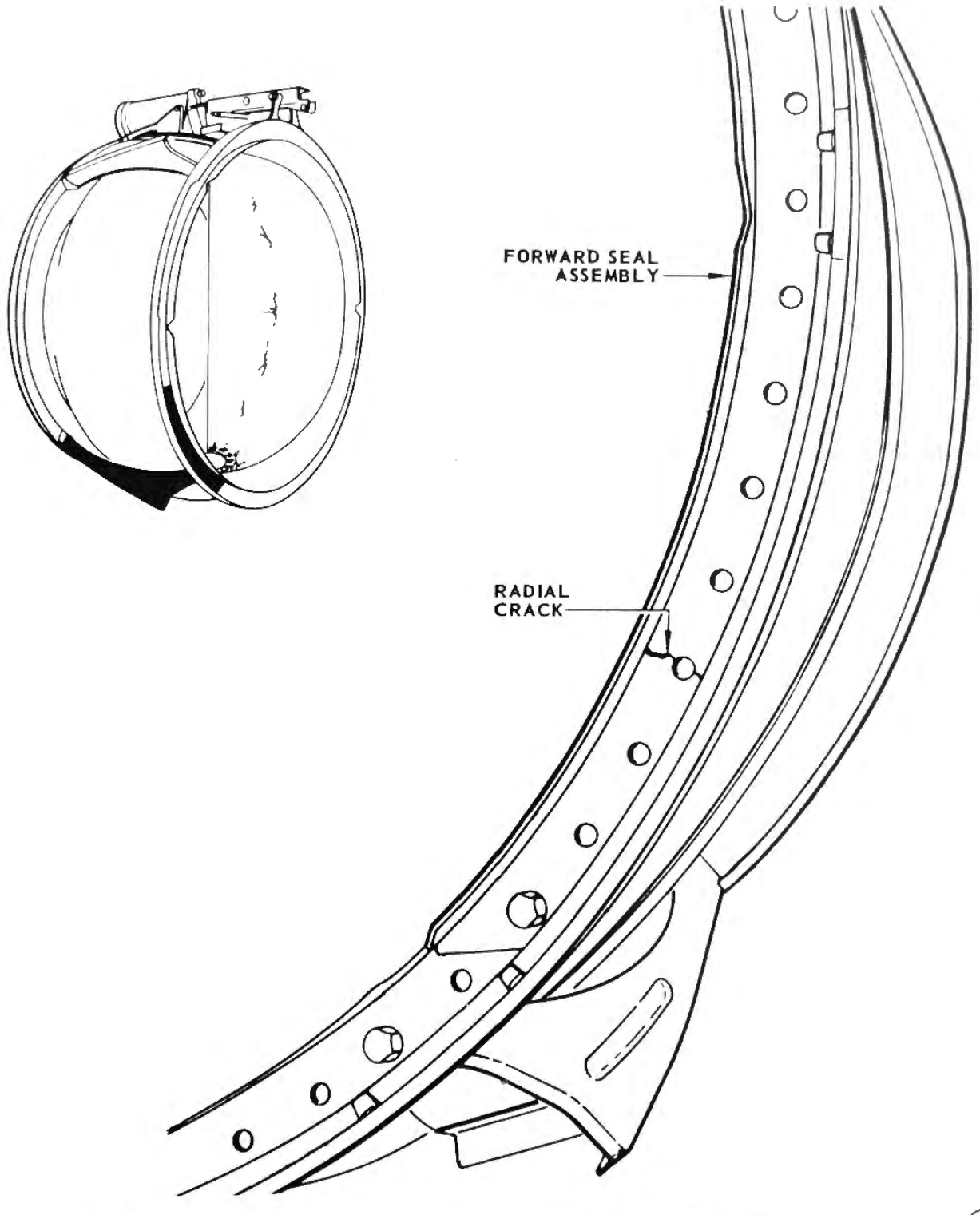
(a) The loss of one or the other of two overlapping seal leaf segments is permissible.

(b) The loss of both overlapping seal leaf segments totaling a maximum of five leaf spaces on both right hand and left hand clamshell doors is permissible before repair is required.



E. Examine Forward Seal Mounting Ring

(1) Examine forward seal mounting ring for radial cracks. Figure 214 shows the nature that such a crack could be expected to assume.



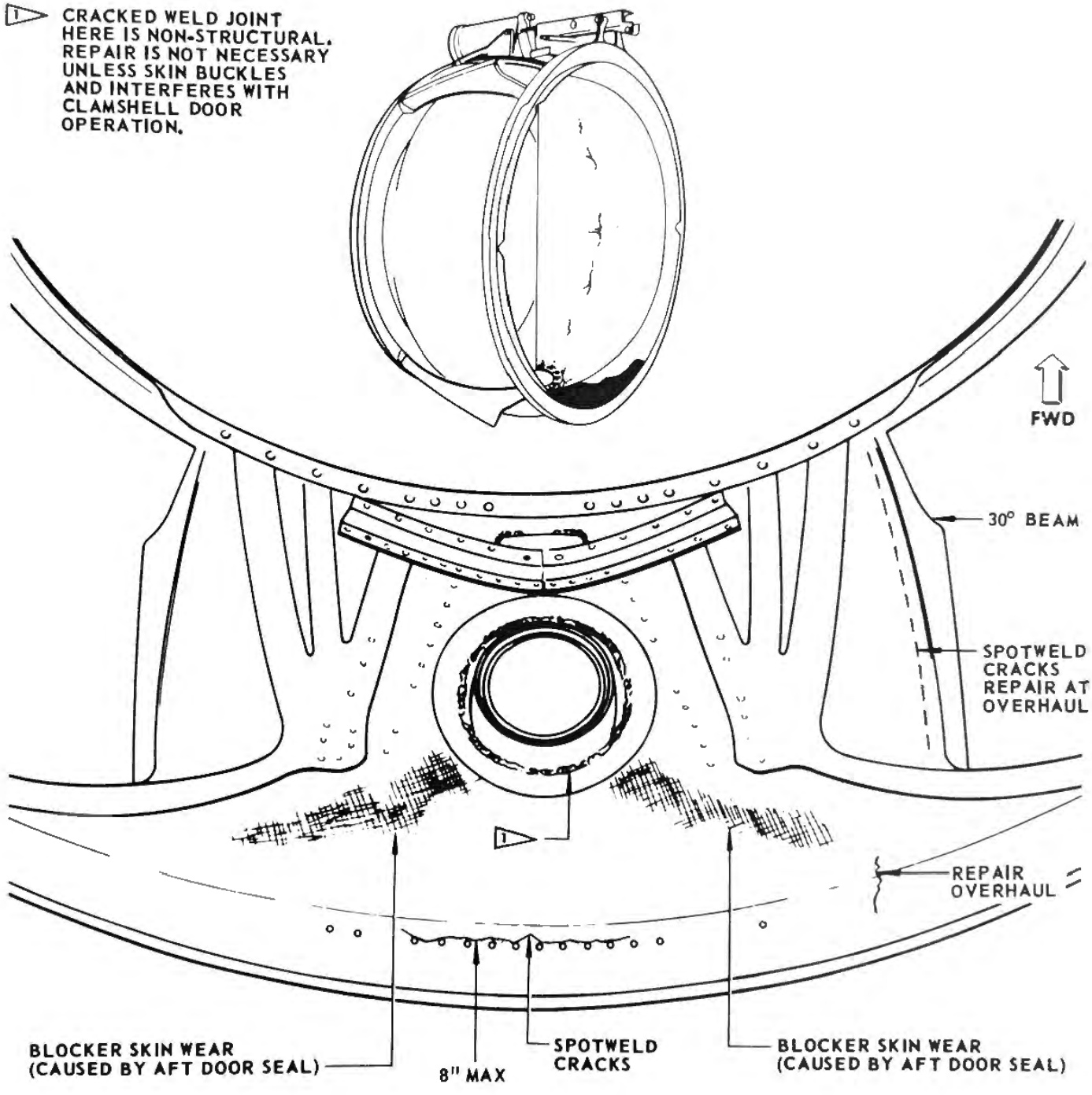
Radial Crack - Thrust Reverser Forward Mounting Ring
Figure 214

F. Examine Ring and Deflector Assembly

(1) Examine blocker skin for wear which can be caused by aft door seal contact as shown in figure 215.

(2) Check for cracked spotwelds where blocker skin is attached to the aft ring.

NOTE: A bump or wrinkle sometimes forms just ahead of the spotweld. Such a wrinkle, once formed, will probably not increase in size or do any damage.

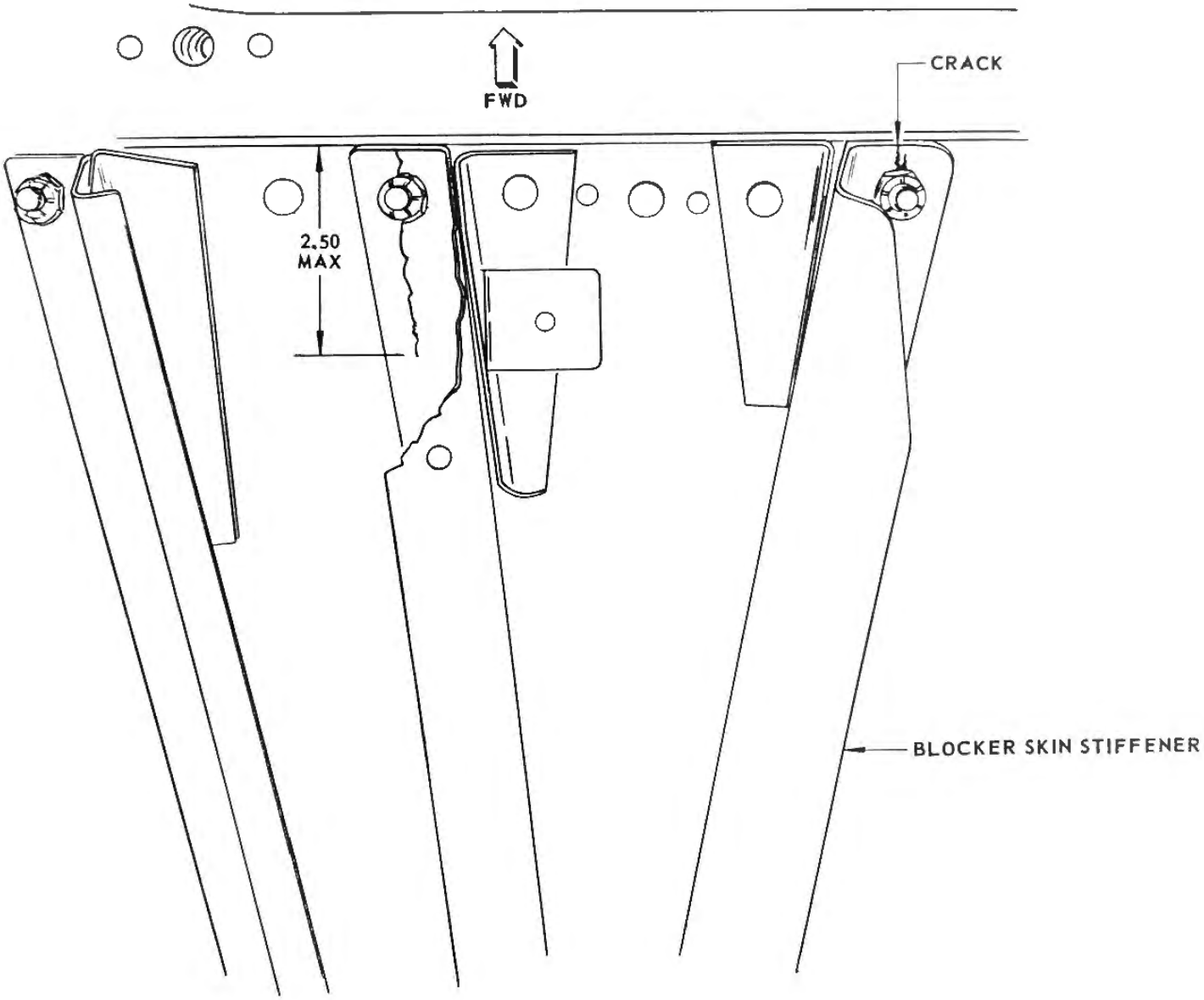


Typical Repair Items - Blocker Skin
Figure 215

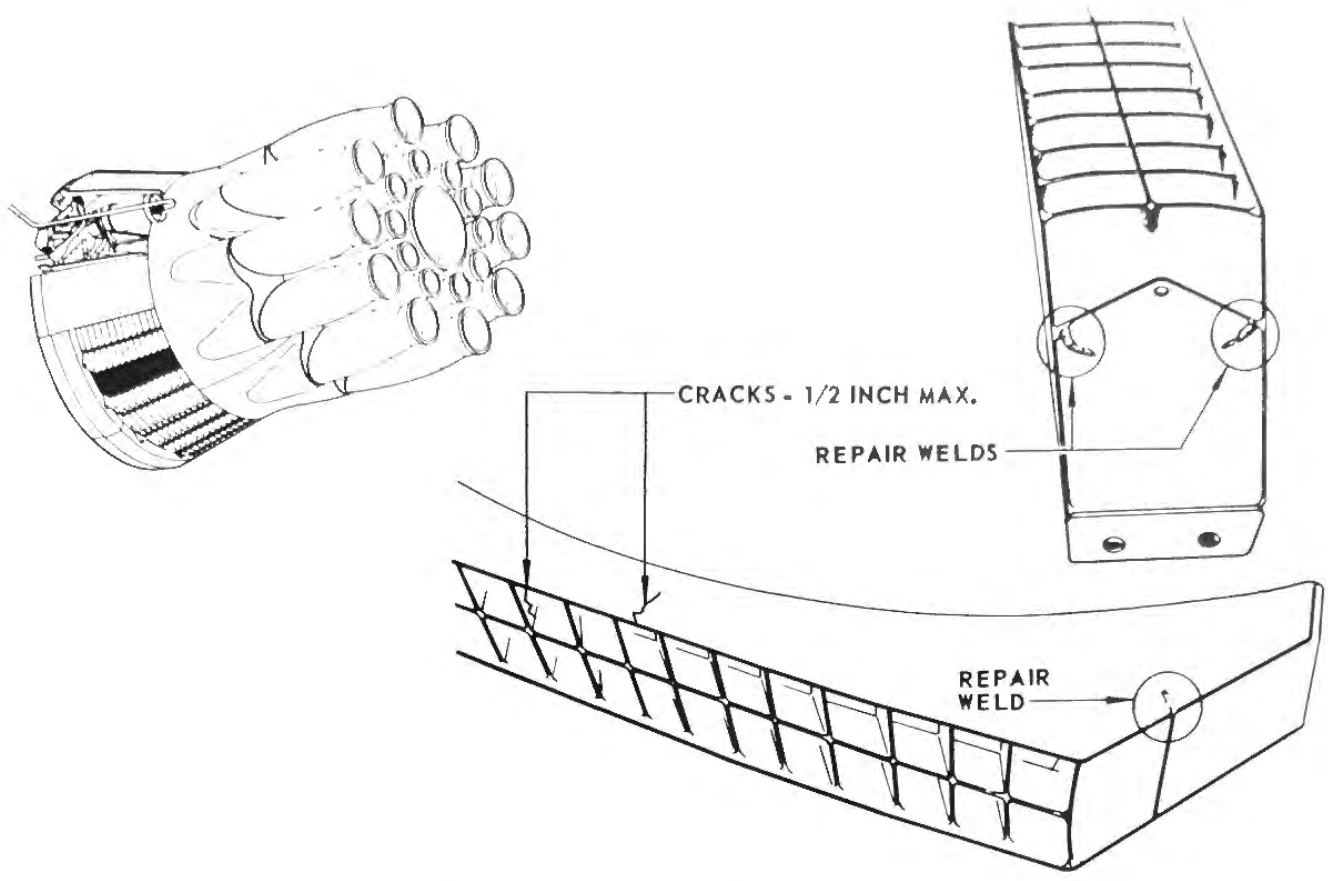
(3) Check for cracks which may occur in attaching brackets of the blocker stiffener assembly as shown in figure 216.

G. Examine Cascade Vane Assemblies (See figures 217 and 218.)

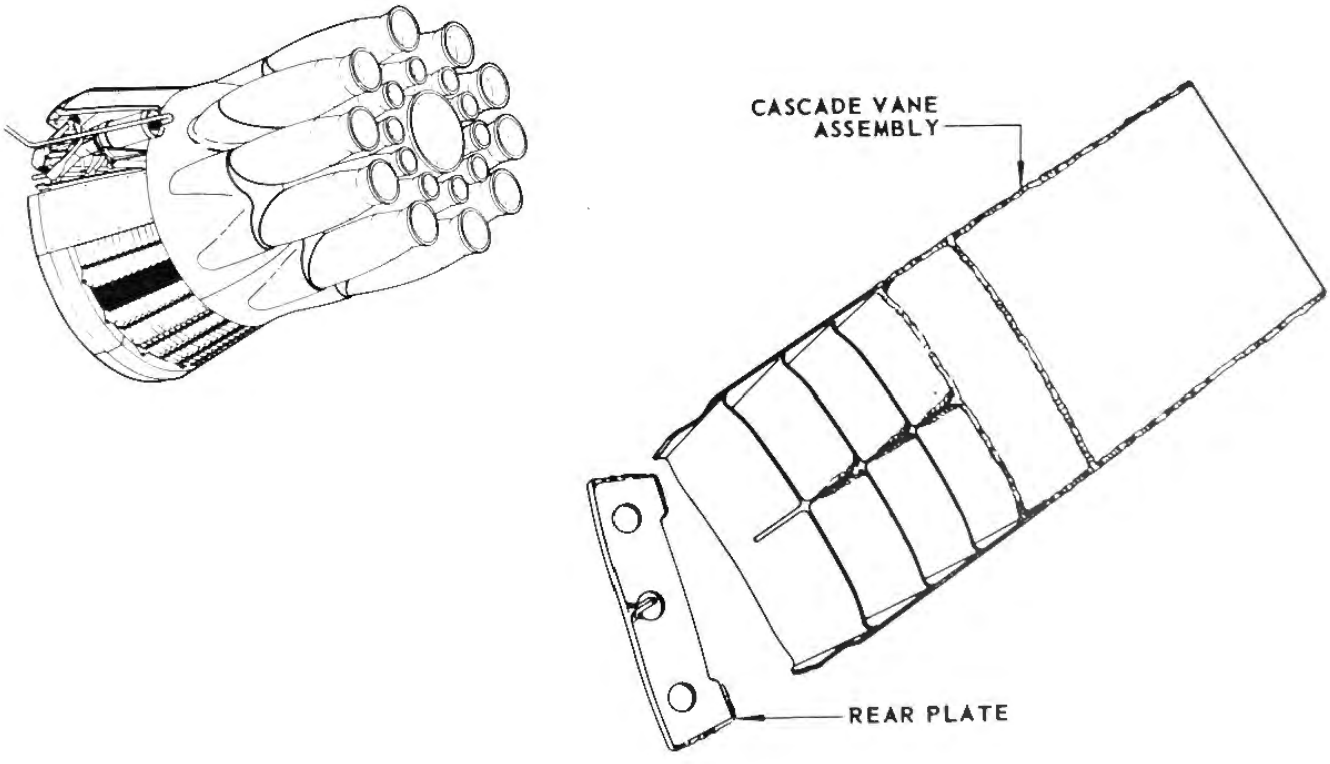
(1) Check for cracks and missing vanes in cascade vane assemblies.



Typical Crack - Blocker Stiffener Attachment Bracket
Figure 216



Typical Cracks - Cascade Vane Assemblies
Figure 217



Cascade Vane Assembly Rear Plate Separation
Figure 218

4. Approved Repairs Thrust Reverser

A. General

(1) Maintenance and repair of the thrust reverser consists largely of welding. All components are of stainless steel (AISI 321), except vane assemblies which are of Hastelloy-X and hub attach fittings which are of N-155 casting material. Welding should be by the inert-gas, tungsten-arc process (Heliarc). Experience has shown that repairs can be made quickly, easily, and in a routine manner if the welder is experienced.

(2) Parts must not be pickled before welding. As a class, stainless steels are sensitive to hydrogen. The alloy used in the thrust reverser is subject to embrittlement if exposed to a rich source of hydrogen. Such a source would be provided by the acids used in a pickling solution. Before welding, parts should be degreased by any of the liquid or vapor methods employed for other aircraft parts.

B. Equipment and Materials

(1) Inert tungsten arc welding equipment.

(2) Bare filler wire - Hastelloy W, 19-9WX or AISI 347.

C. Repair Forward Seal Assembly

(1) Repair cracks in forward seal assembly "V" notches by reworking the "V" into a "U" and then running a welding bead around the edges of the "U". (See figure 210.) Make depth of "U" notch no greater than existing depth of "V" notch.

(2) Circumferential cracking of the forward seal assembly as shown in firgure 211 may cause separation of seal from clamshell door or in the extreme case, loss of an entire seal segment. Replace missing or damaged seal segment.

(3) A few isolated cracks on the inner surface of the seal segments are not serious. Cracks in the segments on the horizontal centerline are more serious than those on the vertical centerline. If three or more cracks form a continuous line, they should be welded at overhaul. If seal has separated from mounting flange, repair as soon as possible. (See figure 212.)

D. Repair Forward Seal Mounting Ring

(1) Repair cracks in forward seal mounting ring (figure 214) by welding. Ream mounting hole after welding bead has been ground flush on both sides.

E. Repair Ring and Deflector Assembly (Figure 215)

(1) Repair blocker skin wear caused by aft door seal contact at overhaul if a groove deeper than 50 percent of the skin's original thickness is formed. Fill groove with welding bead and grind bead flush with the skin.

(2) Cracked spotwelds where blocker skin attachs to aft ring should be repaired during overhaul. Bumps or wrinkles which have formed ahead of the spotweld require no repair action and should be left alone.

(3) Repair cracks in blocker stiffener assembly attaching brackets (figure 216) by welding during overhaul. Use Hastelloy "W" filler rod only. The bracket shown in figure 216 is attached both by spotwelds and with bolts. However, earlier thrust reverser units will have rivets instead of bolts through the bracket. The special bolts used are installed with a light drive fit in a reamed hole. Cracks in riveted units may be repaired by welding without removing rivets.

F. Replace Thrust Reverser Forward Seal Assembly

(1) Replacement of thrust reverser forward seal assembly is accomplished by removing thrust reverser. The forward seal is then separated from thrust reverser by removing 24 screws holding forward seal to thrust reverser ring and deflector assembly.

G. Replace Thrust Reverser Aft Seal Assemblies

(1) The aft seals are installed on the aft edges of the clamshell doors and replacement is accomplished by removing the doors. See 78-2-41, "Remove Clamshell Door."

H. Replace Thrust Reverser Hub Seals

(1) The hub seals are installed on the clamshell doors between the doors and door hinges. Replacement is accomplished by removing the doors. See 78-2-41, "Remove Clamshell Door."

END

EXHAUST PLUG - MAINTENANCE PRACTICES

1. Removal/Installation Exhaust Plug

A. General

(1) The exhaust plug may be removed by removing the cascade vane assemblies on either side of the thrust reverser. Only those sections of the exhaust shroud, EGT harness and heat shield covering the cascade vane assembly mounting bolts need be removed.

B. Equipment and Materials

(1) Anti-Seize compound - FEL-PRO C-5 or equivalent (Felt Products Mfg. Co., Chicago 7, Illinois)

C. Remove Exhaust Plug

(1) Remove engine cowl panel either side of engine.

(2) Remove exhaust shroud at thrust reverser forward support ring.

(3) Remove EGT harness located on heat shield forward of thrust reverser attachment bolts.

NOTE: On airplanes not having heat shield remove clamps on EGT harness and shift harness forward to gain access to thrust reverser installation bolts.

(4) Remove heat shield.

(5) Remove cascade vane assemblies.

(a) Remove bolts holding vane assemblies to thrust reverser forward support ring.

(b) Remove assemblies by lifting out and forward from thrust reverser.

(6) Manually move clamshell doors to reverse thrust position.

(7) Remove bolts in exhaust plug support ring holding exhaust plug to engine plug support and remove plug through side opening.

D. Install Exhaust Plug

(1) Coat threaded surfaces and shank to head of all bolts with anti-seize compound prior to installation.

(2) Install exhaust plug by installing bolts holding exhaust plug to engine plug support.

(3) Position cascade vane assemblies to thrust reverser and install bolts.

(a) Install three center vane assemblies as shown in 78-2-11, figure 201.

(b) Install remaining vane assemblies.

NOTE: If installing vane assemblies on inboard side of engine, install blocker assembly in place of vane segment assembly at upper most position.

(4) Install Heat shield.

NOTE: Some airplanes do not have heat shield installation.

(5) Install EGT harness on heat shield.

NOTE: On airplanes not having heat shield reposition EGT harness aft and install clamps.

(6) Install exhaust shroud at thrust reverser forward support ring.

(7) Install engine cowl panels.

2. Inspection/Check Exhaust Plug

A. Visually check that no cracks have developed in exhaust plug.

END

CASCADE VANE ASSEMBLIES - MAINTENANCE PRACTICES

1. Removal/Installation Cascade Vane Assemblies

A. General

(1) The cascade vane assemblies may be removed without removing the thrust reverser.

B. Equipment and Materials

(1) Anti-seize compound - FEL-PRO C-5 or equivalent (Felt Products Mfg. Co., Chicago 7, Illinois)

C. Remove Cascade Vane Assemblies

(1) Remove applicable nacelle cowl panel.

(2) Remove applicable thrust reverser fairings and exhaust shroud segments to gain access to portion of thrust reverser forward support ring to which cascade vane assemblies to be removed are bolted.

(3) Disconnect EGT harness as necessary and remove heat shield segments as necessary to gain access to correct cascade vane assembly installation bolts on forward support ring.

NOTE: Some airplanes do not have heat shield installation.

(4) Remove bolts holding vane assemblies to thrust reverser forward support ring.

(5) Remove assemblies by lifting out and forward from thrust reverser.

D. Install Cascade Vane Assemblies

(1) Coat threaded surface and shank to head of all bolts with anti-seize compound prior to installation.

(2) Position cascade vane assembly or assemblies on thrust reverser and attach with 5/16 in. dia by 31/32 long bolts. Install by part number as shown in figure 201.

(3) Install heat shield segments.

NOTE: Some airplanes do not have heat shield installation.

(4) Reconnect EGT harness.

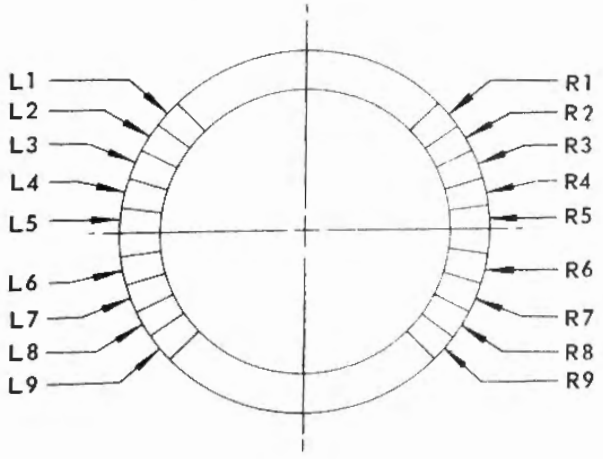
(5) Replace exhaust shroud segments.

(6) Replace thrust reverser fairings.

VANE SEGMENTS

NO.	ENGINE NO. 1	ENGINE NO. 2	ENGINE NO. 3	ENGINE NO. 4
L1	65-12091-4 65-12091-5	65-12091-4 65-12091-5	65-12091-4 65-12091-5	65-12091-4 65-12091-5
L2	65-12062-11 65-22050-10	65-12062-11 65-22050-10	65-12062-11 65-22050-10	65-12062-11 65-22050-10
L3	65-12062-10 65-22050-9	65-12062-10 65-22050-9	65-12062-10 65-22050-9	65-28097-3
L4	65-12062-10 65-22050-9	65-28098-7	65-12062-10 65-22050-9	65-28097-4
L5	65-12061-4 65-22051-4	65-12059-4 65-22053-4	65-12061-4 65-22051-4	65-12060-4 65-22052-4
L6	65-12062-10 65-22050-9	65-28098-8	65-12062-10 65-22050-9	65-12062-13 65-22050-12
L7	65-12062-10 65-22050-9	65-12062-10 65-22050-9	65-12062-10 65-22050-9	65-12062-10 65-22050-9
L8	65-12062-11 65-22050-10	65-12062-11 65-22050-10	65-12062-11 65-22050-10	65-12062-11 65-22050-10
L9	65-12062-12 65-22050-11	65-12062-12 65-22050-11	65-12062-12 65-22050-11	65-12062-12 65-22050-11

TYPICAL ALL FOUR ENGINES



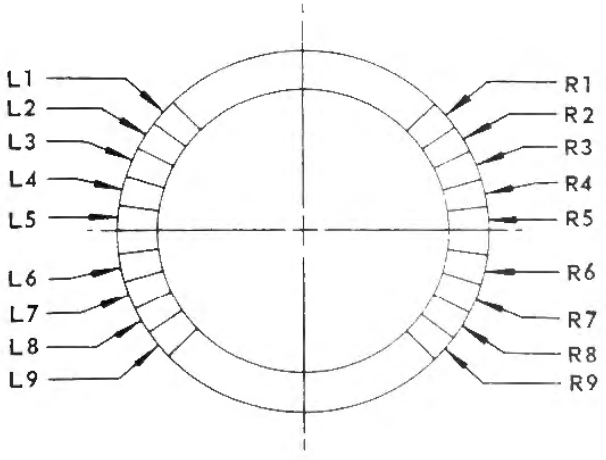
REAR VIEW
(Looking Forward)

Cascade Vane Assembly Locations
Figure 201 (Sheet 1 of 2)

VANE SEGMENTS

NO.	ENGINE NO. 1	ENGINE NO. 2	ENGINE NO. 3	ENGINE NO. 4
R1	65-12091-4 65-12091-5	65-12091-4 65-12091-5	65-12091-4 65-12091-5	65-12091-4 65-12091-5
R2	65-12062-11 65-22050-10	65-12062-11 65-22050-10	65-12062-11 65-22050-10	65-12062-11 65-22050-10
R3	65-28097-3	65-12062-10 65-22050-9	65-12062-10 65-22050-9	65-12062-10 65-22050-9
R4	65-28097-4	65-12062-10 65-22050-9	65-28098-8	65-12062-10 65-22050-9
R5	65-12060-4 65-22052-4	65-12061-4 65-22051-4	65-12059-4 65-22053-4	65-12061-4 65-22051-4
R6	65-12062-13 65-22050-12	65-12062-10 65-22050-9	65-28098-7	65-12062-10 65-22050-9
R7	65-12062-10 65-22050-9	65-12062-10 65-22050-9	65-12062-10 65-22050-9	65-12062-10 65-22050-9
R8	65-12062-11 65-22050-10	65-12062-11 65-22050-10	65-12062-11 65-22050-10	65-12062-11 65-22050-10
R9	65-12062-12 65-22050-11	65-12062-12 65-22050-11	65-12062-12 65-22050-11	65-12062-12 65-22050-11

TYPICAL ALL FOUR ENGINES

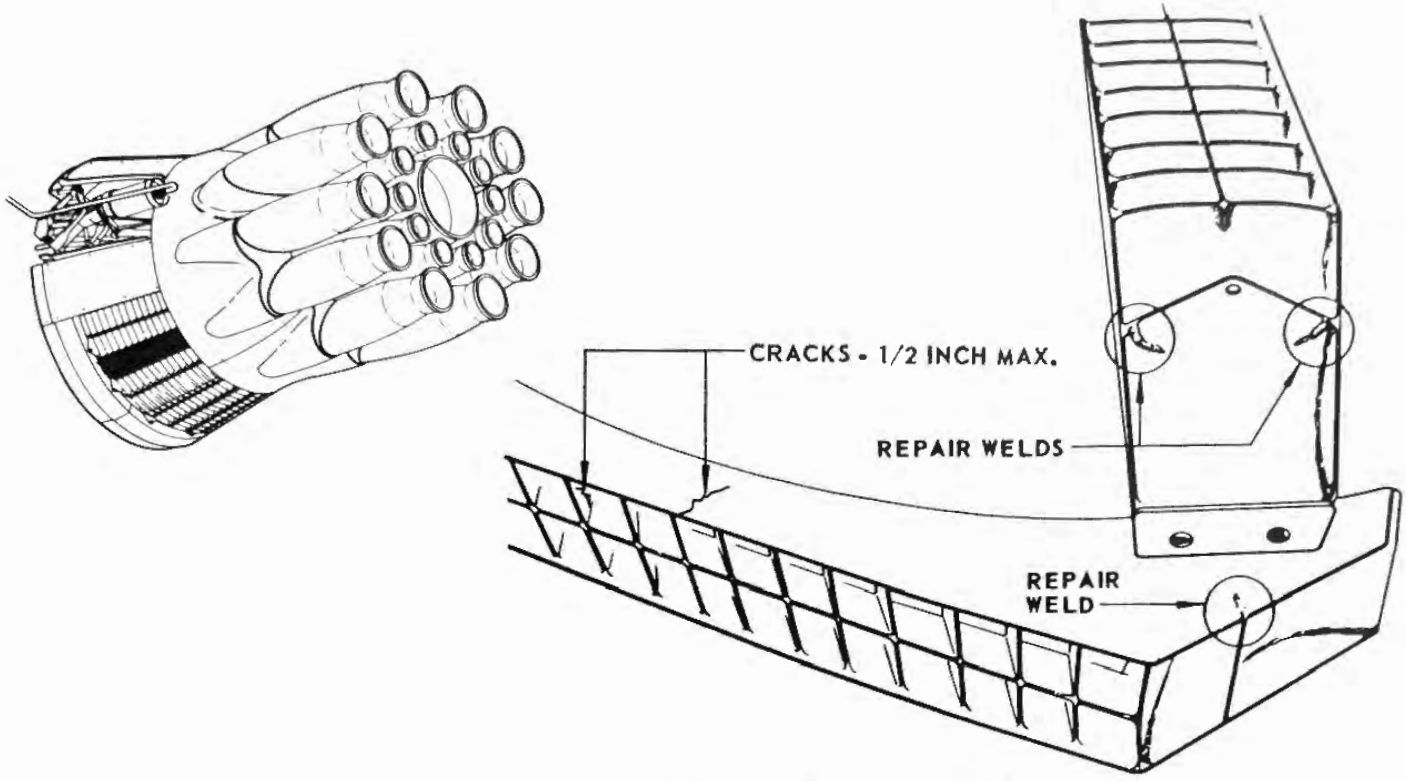


REAR VIEW
(Looking Forward)

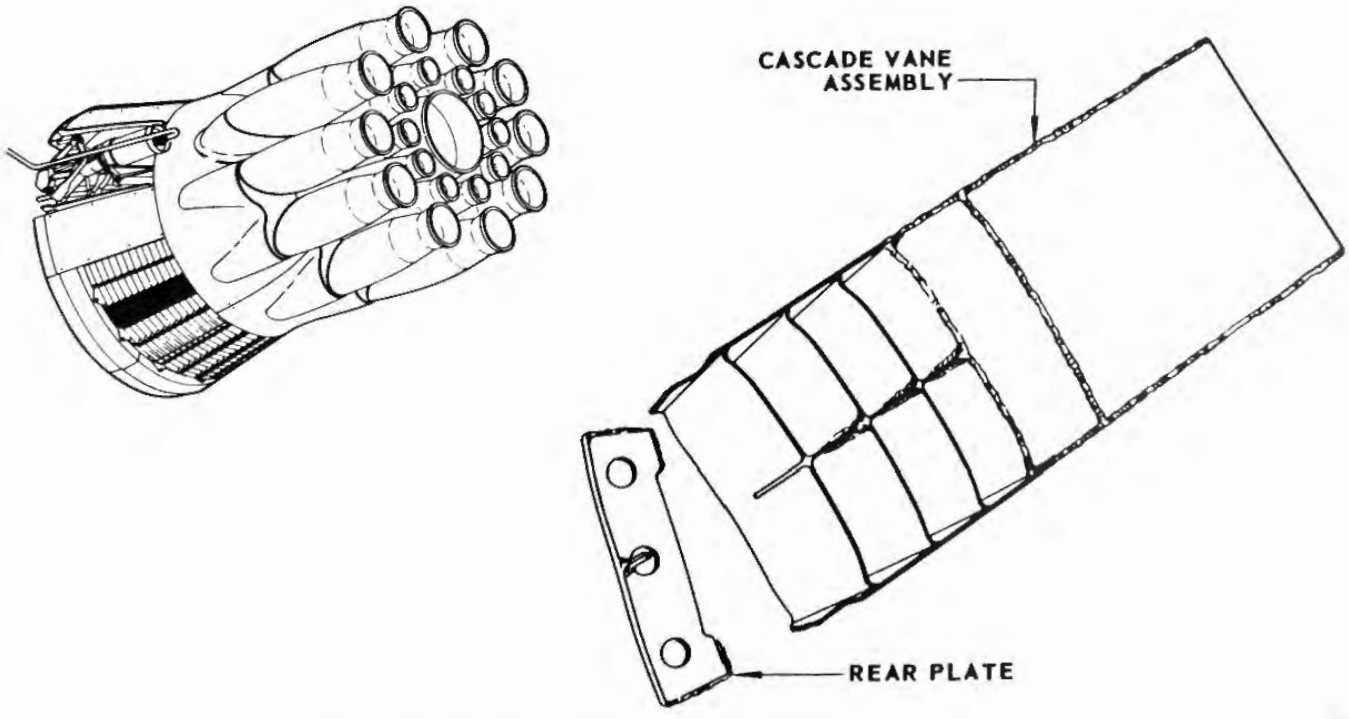
2. Inspection/Check Cascade Vane Assemblies

A. Examine Cascade Vane Assemblies (See figures 202 and 203.)

(1) Check for cracks and missing vanes in cascade vane assemblies.



Typical Cracks - Cascade Vane Assemblies
Figure 202



Cascade Vane Assembly Rear Plate Separation
Figure 203

3. Approved Repairs Cascade Vane Assemblies

A. Equipment and Materials

(1) Inert tungsten arc welding equipment

(2) Hastelloy W filler wire

B. Repair Cascade Vane Assemblies

(1) Repair cracks in vane segment assemblies by welding. Use Hastelloy "W" filler wire only. Typical repairs are shown in figure 202. If rear plate is completely separated from vane assembly as shown in figure 203, remove vane assembly and limit thrust reverser operation to emergency use only. Complete loss of a single vane or several vanes in a segment assembly is probably not detrimental to operation of the airplane. However, maximum performance of the thrust reverser can be expected only with all vanes in place.

END

CLAMSHELL DOORS - MAINTENANCE PRACTICES

1. Removal/Installation Clamshell Door

A. Equipment and Materials

(1) Air pressure source - 0 to 200 psig capacity.

(2) Anti-seize compound - FEL-PRO C-5 or equivalent (Felt Products Mfg. Co., Chicago 7, Illinois).

B. Remove Clamshell Door

(1) Open left nacelle cowl panel.

(2) Remove nacelle aft fairing. See Access Doors and Panels, Chapter 12.

(a) Remove fairing 759 on outboard engines.

(b) Remove fairing 712 on inboard engines.

(3) Remove nacelle auxiliary fairings.

(a) Remove fairing 761 on outboard engines.

(b) Remove fairing 727 on inboard engines.

(4) Remove thrust reverser top fairings.

(5) Remove thrust reverser keel fairing.

(6) Remove sound suppressor. See 78-2-1, "Remove Sound Suppressor".

(7) Disconnect actuator links from hinge arms.

(8) Manually rotate clamshell doors to forward thrust position.

(9) Remove bolts holding clamshell door to hinge assembly.

(10) Use tool as shown in figure 201 to compress door so that hub seal on door clears inner skin of ring and deflector assembly and remove door through rear of thrust reverser.

CAUTION: EXERCISE CARE WHEN REMOVING DOOR TO PREVENT DAMAGE TO HUB SEAL.

C. Install Clamshell Door

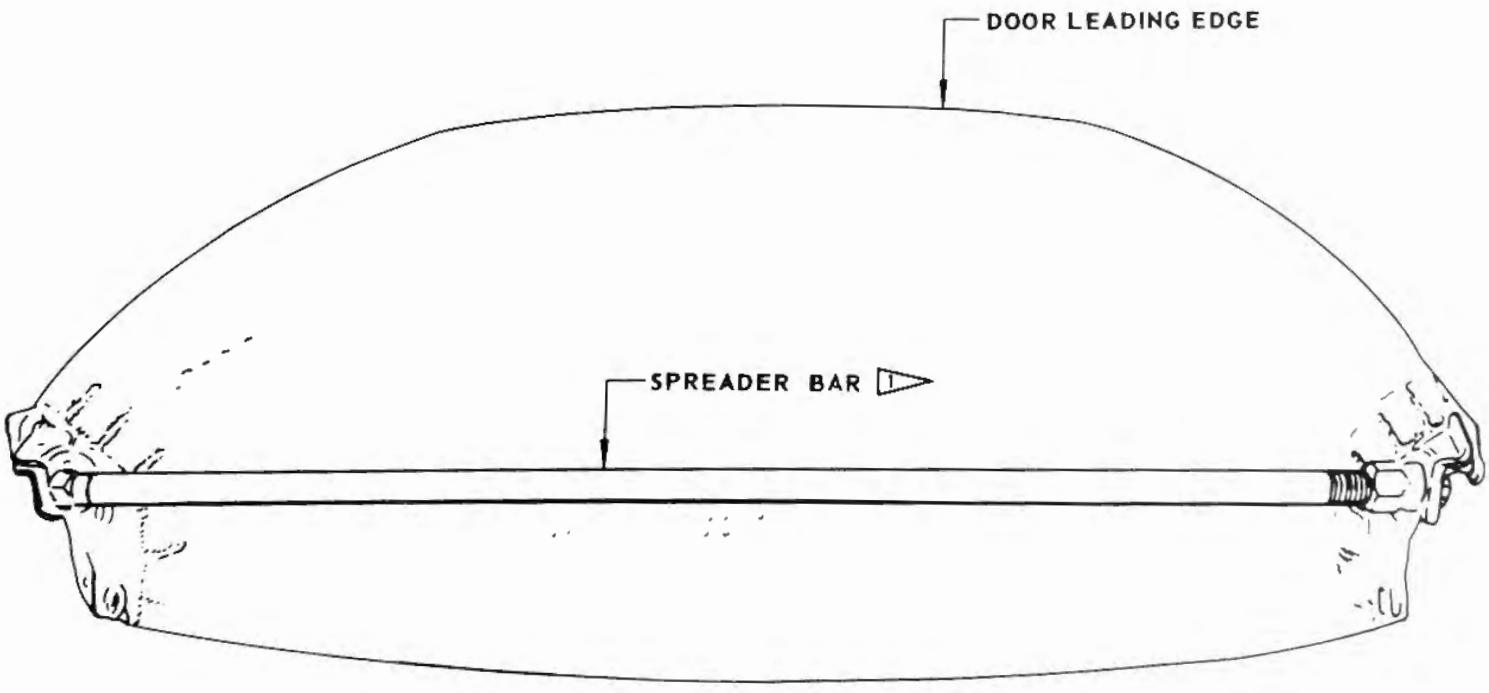
(1) Coat threaded surfaces and shank to head of all bolts and screws with anti-seize compound prior to installation.

(2) Use tool as shown in figure 201 to compress door to clear inner skin of ring and deflector assembly.

(3) Position door on hinge assemblies in thrust reverser and start several bolts on each end of door.

(4) Remove spreader bar .

1 SEE BOEING DRAWING L.O.6-7161-2-59 TO FABRICATE SPREADER BAR



Spreader Bar Application
Figure 201

(5) Install remaining bolts through door fitting and hinge face.

NOTE: Use .032 thick corrosion resistant steel shims if necessary to maintain 30.34 ± .02 inch dimension between outer faces of clamshell door at mounting bolts. One shim maximum per side.

(6) Connect external air pressure source to ground air shuttle valve and regulate to 25 psig to hold pistons against their internal stops.

NOTE: Volume capacity of air source is important. Therefore, minimum ground air line size should be equivalent to normal thrust reverser pressure line. The gage should be located close to the ground connection shuttle valve.

(7) Manually position doors in forward thrust position.

(8) Lock doors in forward thrust position by inserting NAS 501 rigging bolt through hinge arms. (See 78-2-11, figure 205.)

(9) Adjust actuator links to fit hinge arms and tighten check nut.

(10) Connect links to hinge arms.

(a) Position links to hinge arms and install bolts with bolt shanks pointing toward thrust reverser.

(b) Install washer, nut and cotter pin. Install warning light switch actuator on upper left hinge arm.

(c) Install cotter pin.

(11) Release air pressure from head ports of actuators.

(12) Remove rigging bolts from hinge arms.

(13) Install thrust reverser keel fairing.

(14) Install thrust reverser top fairings.

(15) Install nacelle strut auxiliary fairing.

(16) Install nacelle aft fairing.

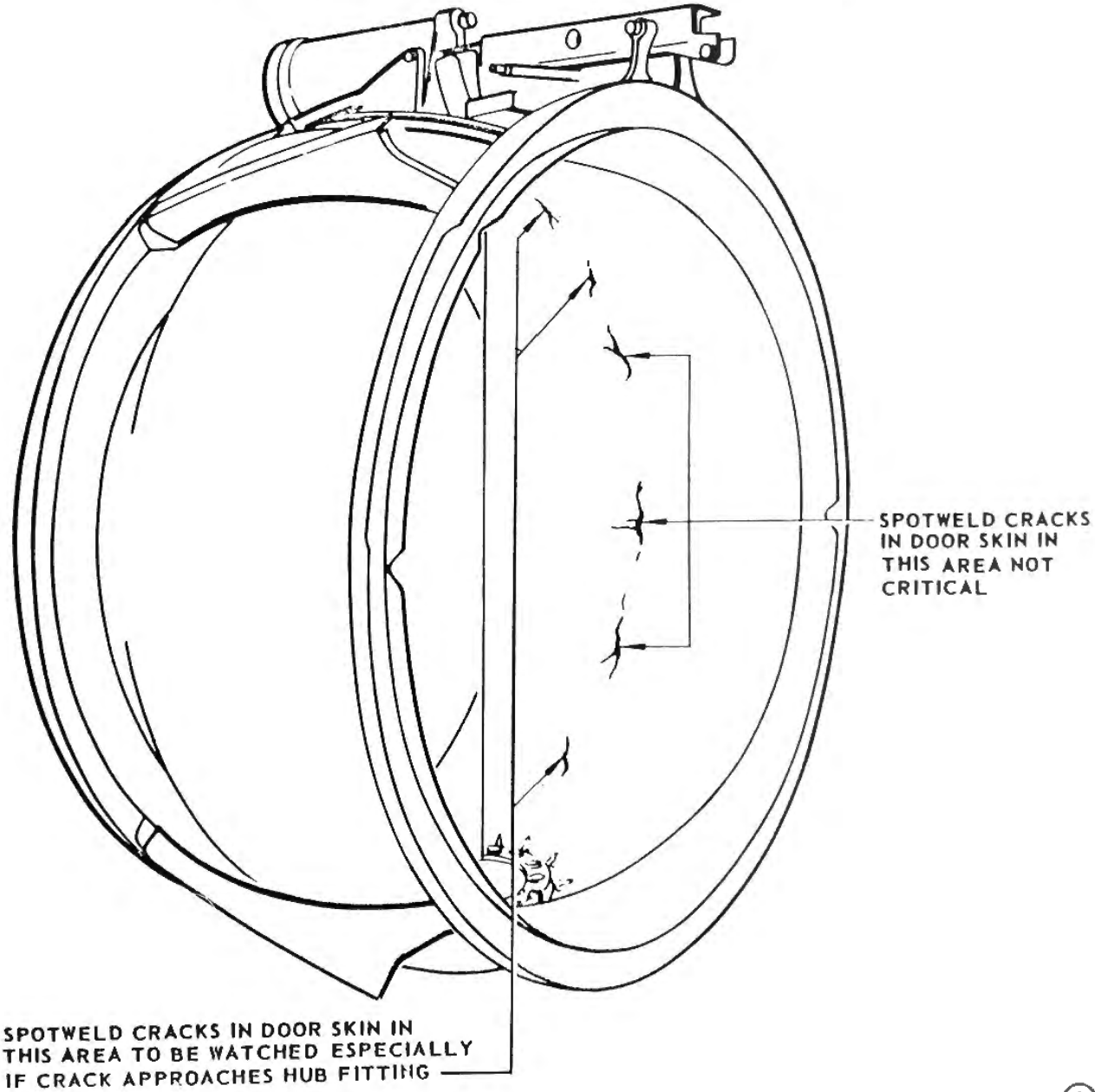
(17) Install nacelle cowl panels.

2. Inspection/Check Clamshell Doors

A. Examine Clamshell Doors

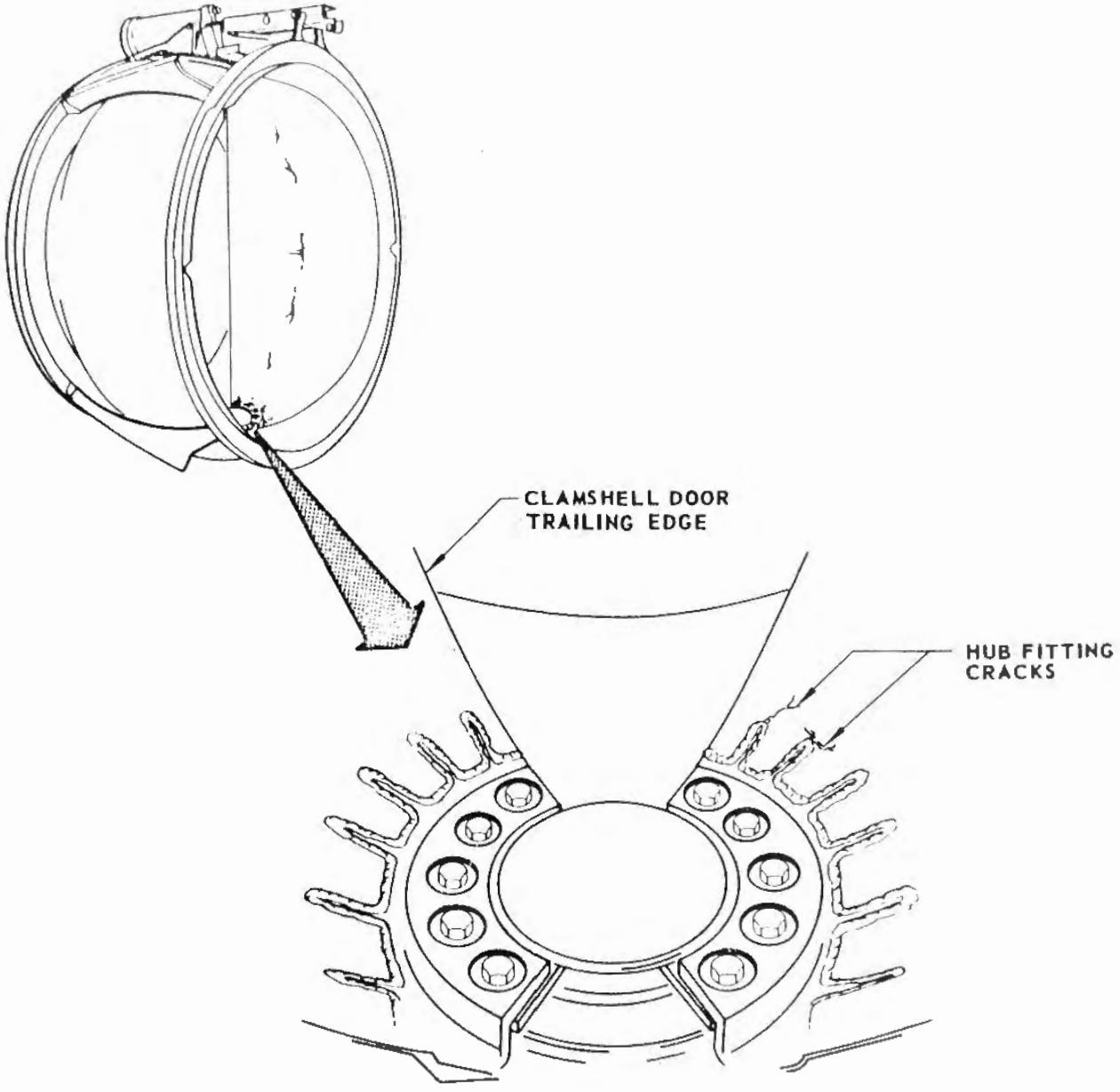
(1) Examine inner skin of clamshell door for spotweld cracks. These cracks result from differential expansion between inside and outside skin. Usually cracks do not progress after the material has relieved itself. The recommended maintenance procedure is to keep the cracks under surveillance. Need for repair depends on location of cracks and their rate of increase. Figure 202 shows area to be inspected for cracks.

NOTE: Differences in temperature between the door inner skin and the outer skin may also produce wrinkles. The structure of the door includes internal hat-section reinforcing to which the skins are spotwelded. Wrinkles may form between the rows of spotwelds. Such wrinkling is not detrimental to operation of thrust reverser; no repair or rework is required.



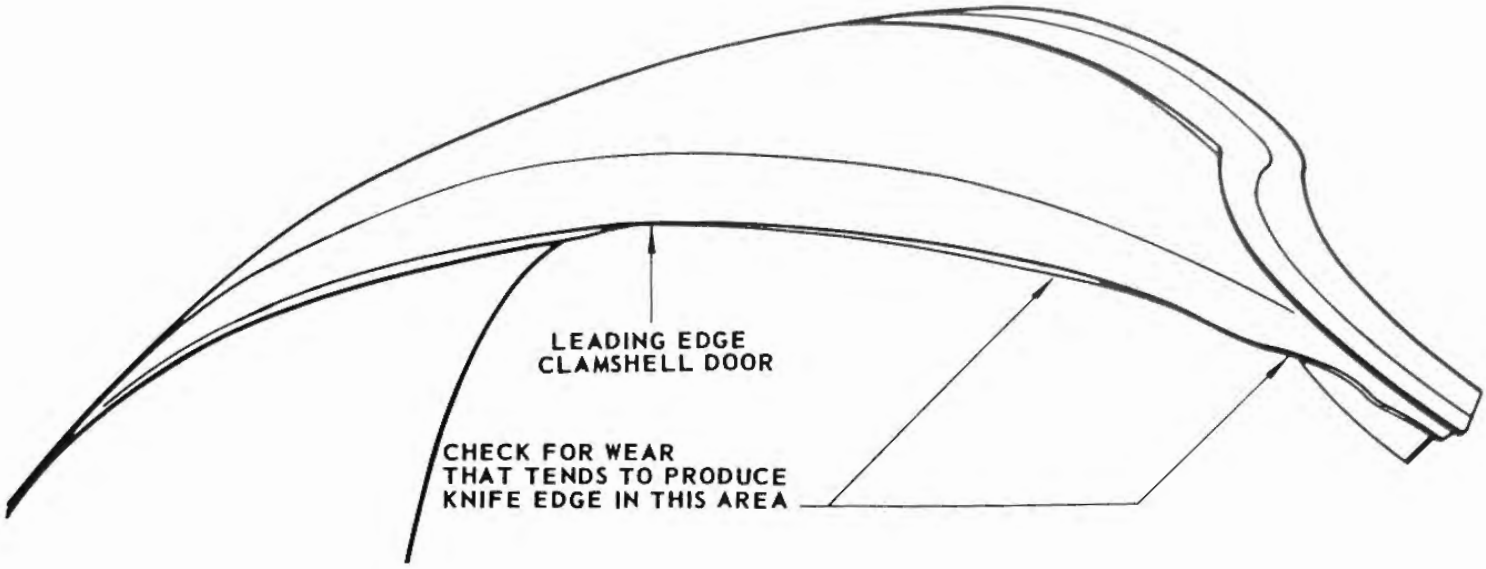
Typical Cracks Clamshell Door
Figure 202

(2) Check for cracks near the welding beads in hub area. Such cracks can be expected to assume the appearance illustrated in Figure 203.



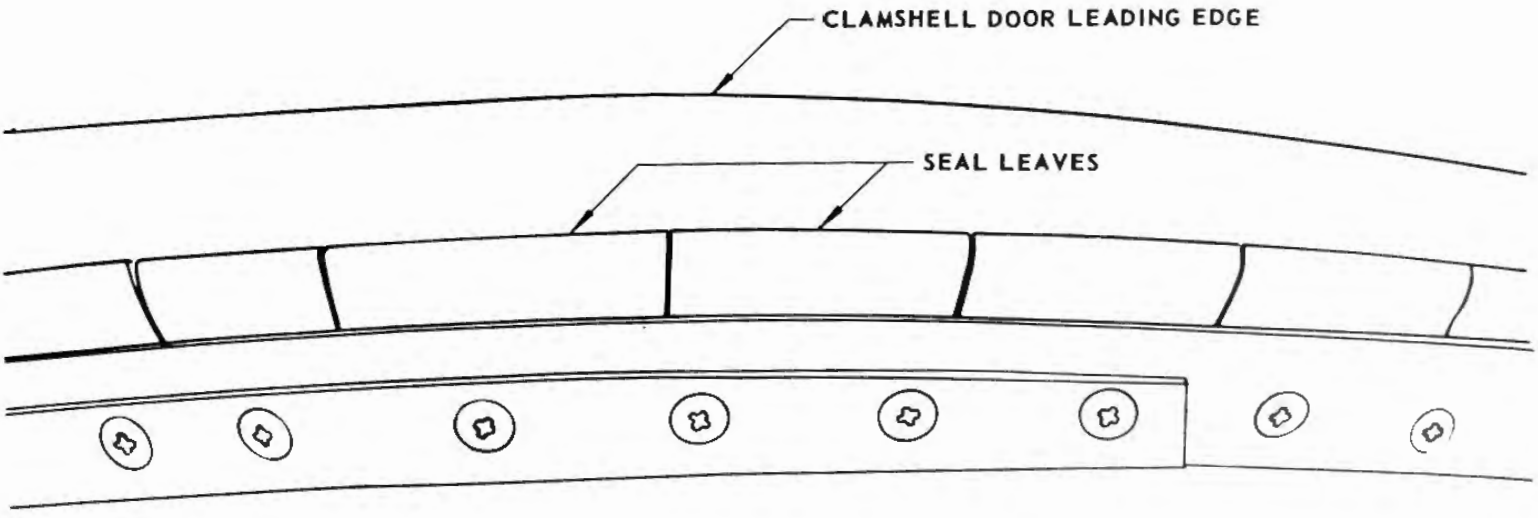
Clamshell Door Hub Crack Location
Figure 203

(3) Check for excessive wear of door leading edge. Such wear may produce a sharp edge in the area indicated in Figure 204.



Clamshell Door Leading Edge Wear Location
Figure 204

(4) Check for missing seal leaves on aft door seal; the seal is located on the door trailing edge and contains an inner and an outer overlapping layer of seal leaves. (See figure 205.)



Clamshell Door Aft Seal Leaves
Figure 205

3. Approved Repairs Clamshell Doors

A. General

(1) Maintenance and repair of the clamshell doors consists largely of contour rework and welding. The doors are of stainless steel (AISI 321) except for the hub attach fittings which are of M-155 casting material. Welding should be by the inert-gas, tungsten-arc process (Heliarc).

(2) Parts must not be pickled before welding. As a class, stainless steels are sensitive to hydrogen. The alloy used is subject to embrittlement if exposed to a rich source of hydrogen. Such a source would be provided by the acids used in pickling solution. Before welding, parts should be degreased by any of the liquid or vapor methods employed for other aircraft parts.

B. Equipment and Materials

(1) Inert tungsten arc welding equipment.

(2) Bare filler wire - Hastelloy W, 19-9WX or AISI 347.

(3) Spreader bar.

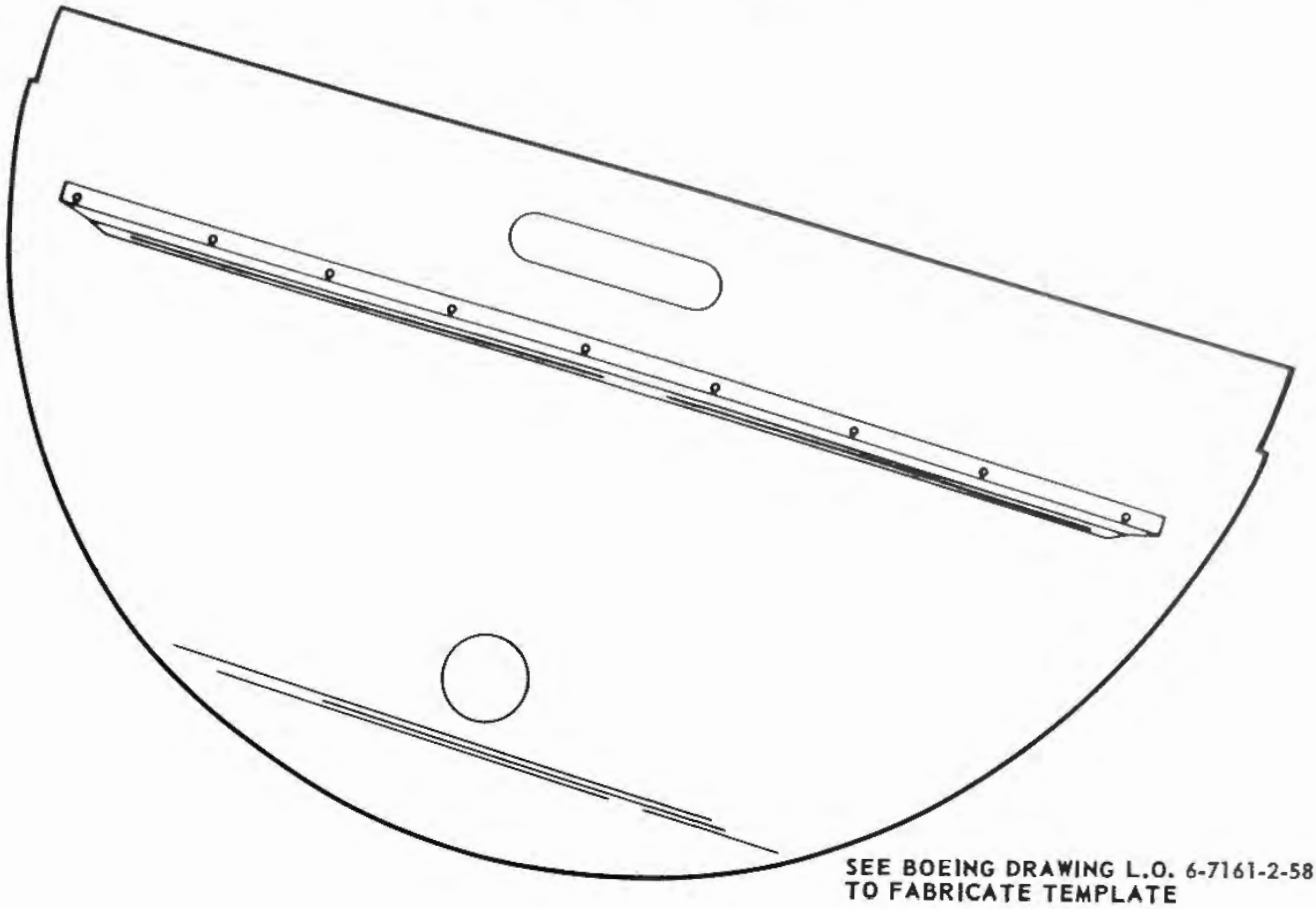
(4) Clamshell door contour template.

C. Repair Clamshell Doors

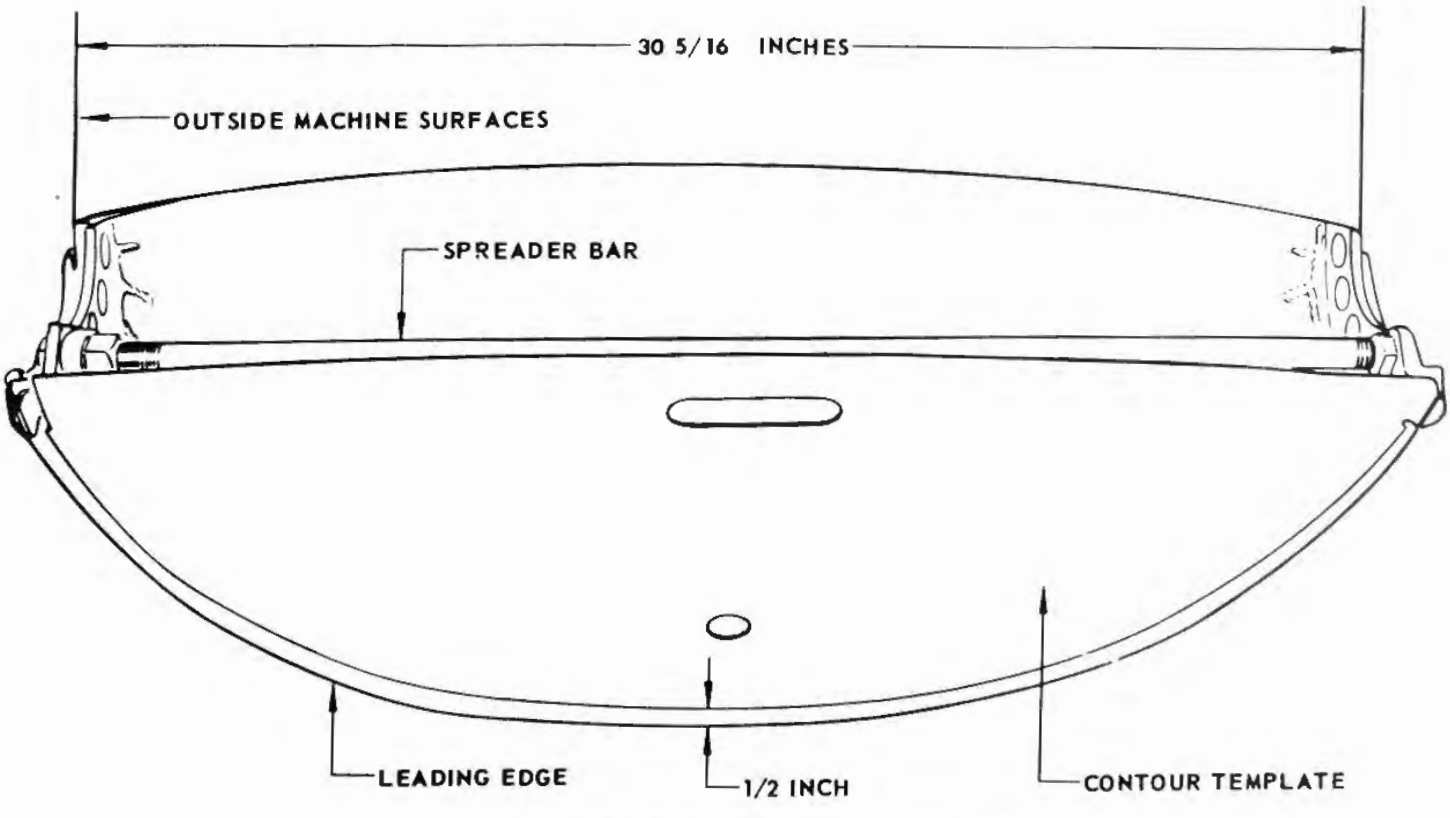
(1) If the leading edges of the clamshell doors do not properly mate with forward seal the door is probably out of contour and should be reworked. (See 78-2-11, figure 206.)

(a) In some cases, the leading edges of the doors can be reworked on the engine. Access to the doors can be gained by removing the vane segment assemblies. The doors are easily disconnected from the actuator links so that they can be moved by hand.

(b) If the thrust reverser is off the engine and the doors are out of contour, remove them from the rest of the thrust reverser. With doors removed, the template shown in figure 206 may be used to establish the correct contour. In conjunction with the template, a spreader bar as shown in figure 201 is recommended. The spreader bar aids in establishing correct spacing between door fittings and holds door during rework. Figure 207 shows recommended use of template and spreader bar for checking door contour. The spreader bar can be made easily from material normally found in a machine shop. The correct distance between machined faces of the hub fittings is 30-5/16 inches. A 90% seal contact should be established by hand contouring the door.



Clamshell Door Contour Template
Figure 206



Spreader Bar and Template Installed
for Contour Rework
Figure 207

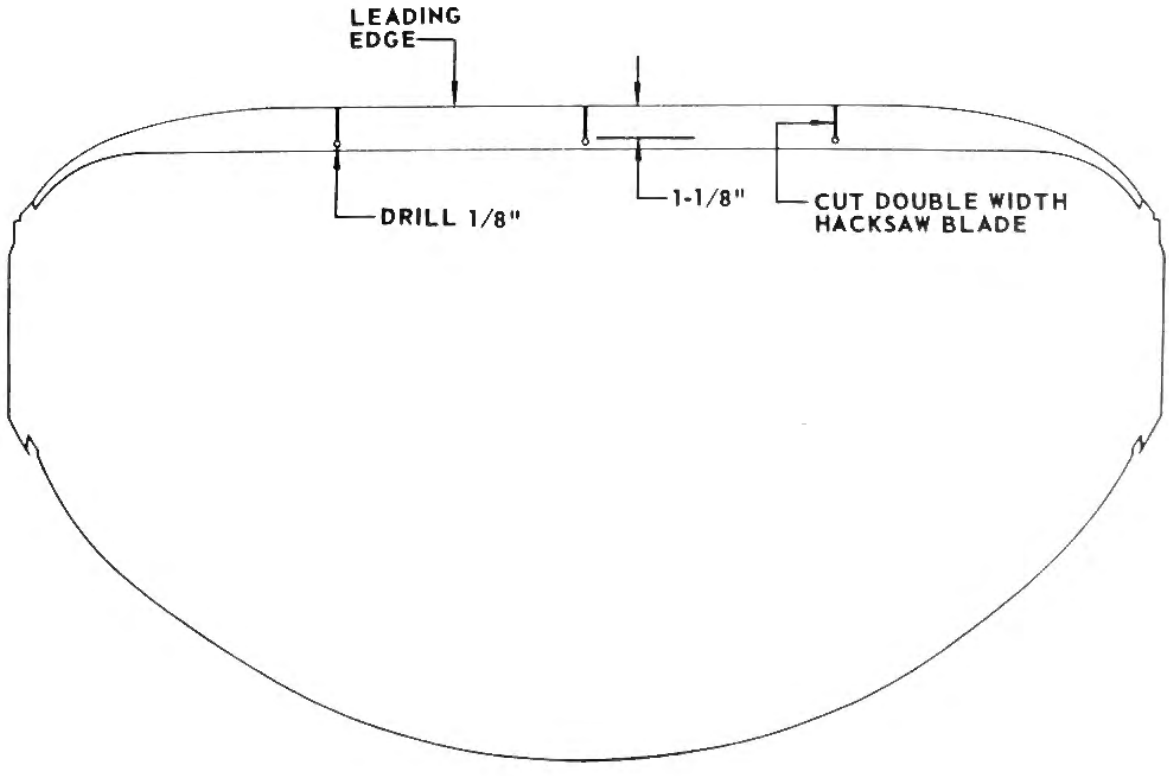
(c) If excessive diameter growth will not allow a door to be brought into contour readily, excess material may be removed by slitting the leading edge. The general nature of this operation is shown in figure 208. The number of slits required will depend on the amount of gap; up to 4 slits are permissible. After slitting and reforming the leading edge to the correct contour, weld slits and holes and grind weld bead flush.

(d) Keep spotweld cracks on inner skin of door under surveillance. Need for repair depends on location of cracks and their rate of increase. (See figure 202.) Repair cracks near hub fitting by welding, especially if they form a continuous line of defects.

(e) Cracks near the welding beads in the hub area (figure 203) should be repaired by welding as soon as the airplane reaches a base having the necessary facilities. Because of the nature of the hub material (N-155 casting material), the use of Hastelloy "W" filler rod only is recommended for repairs.

(f) Repair door leading edge if wear produces a sharp edge in area indicated in figure 204. When wear has gone 1/8 inch beyond original edge of door, cut out worn area and insert a new piece of .050-inch AISI 321 material and grind weld beads flush. Check contour of door with the leading edge template before reinstalling door.

(g) Replace missing seal leaves on aft door seal if seal leaves are missing from both inner and outer layer. (See figure 205.) Sealing is not appreciably affected if leaves from only one layer are missing.



Clamshell Door Contour Rework
Figure 208

THRUST REVERSER CONTROL SYSTEM - DESCRIPTION AND OPERATION

1. General

A. The thrust reverser control system directs pneumatic pressure to the clamshell door actuators which position the clamshell doors for the desired forward or reverse thrust operation. For forward thrust operation, the doors are forward in the open position. For reverse thrust operation, the doors move aft and toward the engine centerline to the closed position. The engine will return to the 15 percent thrust position automatically in the event that the doors open during reverse thrust operation, or in the event the doors close during forward thrust operation. This prevents the engine from supplying high thrust opposite to the selected direction.

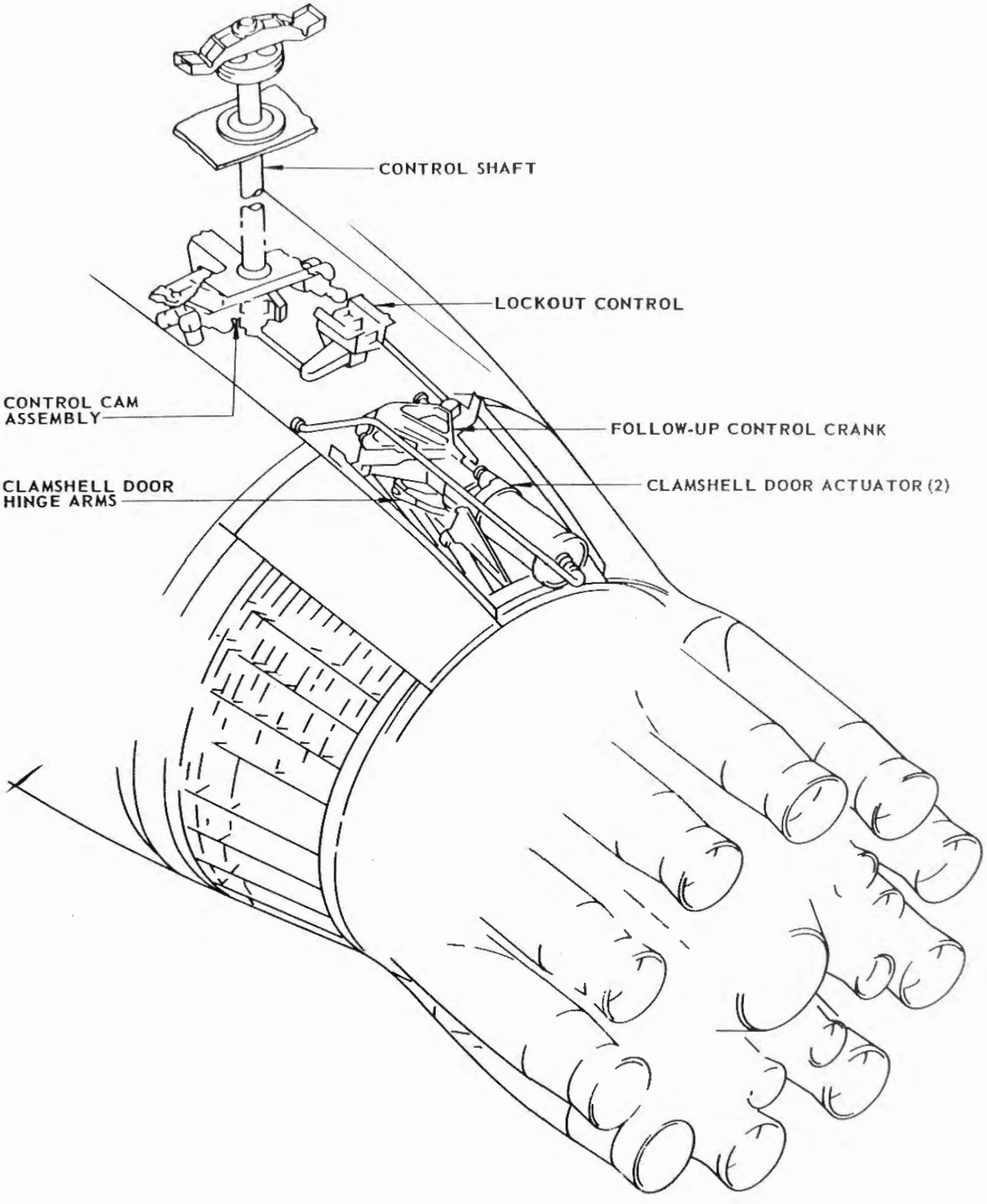
B. The system consists of the control cam assembly, the lockout control, the follow-up control crank, and the clamshell door actuators. (See figure 1.) "Retract" and "extend" directional valves, mounted on the control cam assembly, are controlled by the control cam which is positioned by the forward and reverse thrust levers. (See figure 2.) The directional valves direct pneumatic air to the clamshell door actuators which open and close the clamshell doors. The position of the clamshell doors is controlled by the reverse thrust lever only.

2. Control Cam Assembly

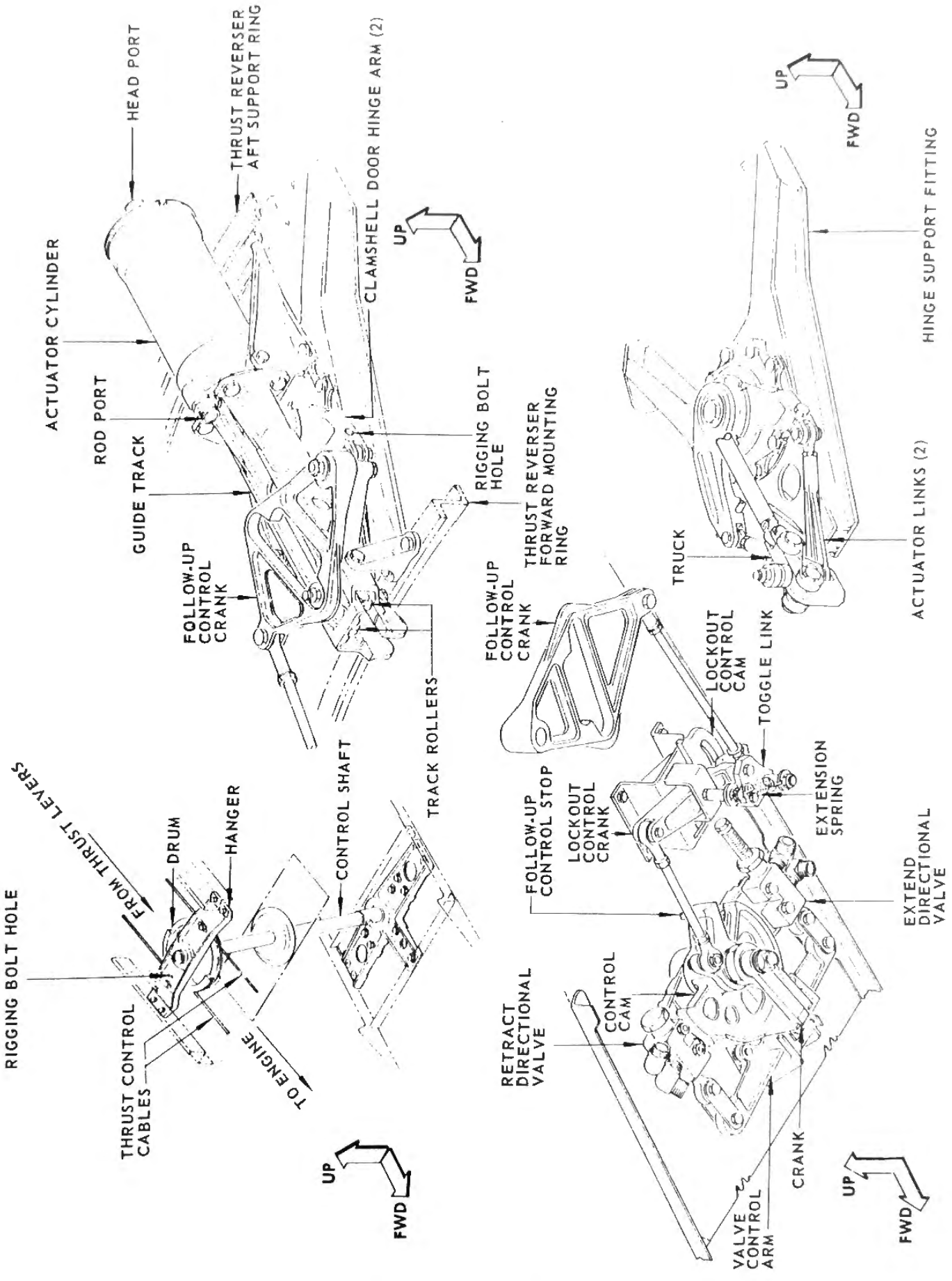
A. The control cam assembly operates the directional valves and consists of a control cam, extend and retract directional valves, valve control arm, and a follow-up control stop. (See figure 2.) The follow-up control stop moves independently of the control cam and is controlled by the lockout control through a rod assembly. The control cam assembly is mounted on a control shaft in the strut and is located above the engine forward of the thrust reverser. The control cam assembly is operated directly from the thrust control cables and operates the directional valves through a valve control arm and roller mechanism.

3. Lockout Control

A. The lockout control on each thrust reverser prevents the respective thrust lever from being moved to the maximum thrust position until the clamshell doors have approached the proper position for forward or reverse thrust operation. The lockout control consists of a control crank, a spring loaded toggle link, and a control cam. (See figure 2.) The control, mounted on a bracket located under the strut and aft of the control cam assembly, is connected to the follow-up control stop through a rod assembly. The lockout control is operated by the follow-up control crank to position the follow-up control stop on the control cam. The force exerted on the follow-up control stop by the lockout control cannot be overcome by the pilots' force on the thrust lever.



Thrust Reverser Control System Component Location
Figure 1



Thrust Reverser Control System
Figure 2

4. Follow-up Control Crank

A. The follow-up control crank governs the position of the control stop on the control cam assembly. The control crank also insures that the thrust levers return to the 15 per cent thrust position if the doors unexpectedly close during forward operation or open during reverse thrust operation. The follow-up control crank is installed on the guide track assembly of the upper door actuator and is connected to the lockout control through a rod assembly. (See figure 2.) The cam action of the control crank limits the crank movement near the end of the door opening and closing cycle only. As the doors approach the fully open or closed position, the truck mechanism in the door actuator guide track engages the follow-up control crank. The follow-up control crank trips the lockout control, thus changing the position of the follow-up control stop on the control cam and permitting the appropriate thrust lever to be advanced toward maximum thrust. Should the doors unexpectedly close during forward thrust operation, or open during reverse thrust operation, the follow-up control crank will reverse the previous sequence of steps and force the follow-up control stop to return the thrust lever to the 15 per cent thrust condition.

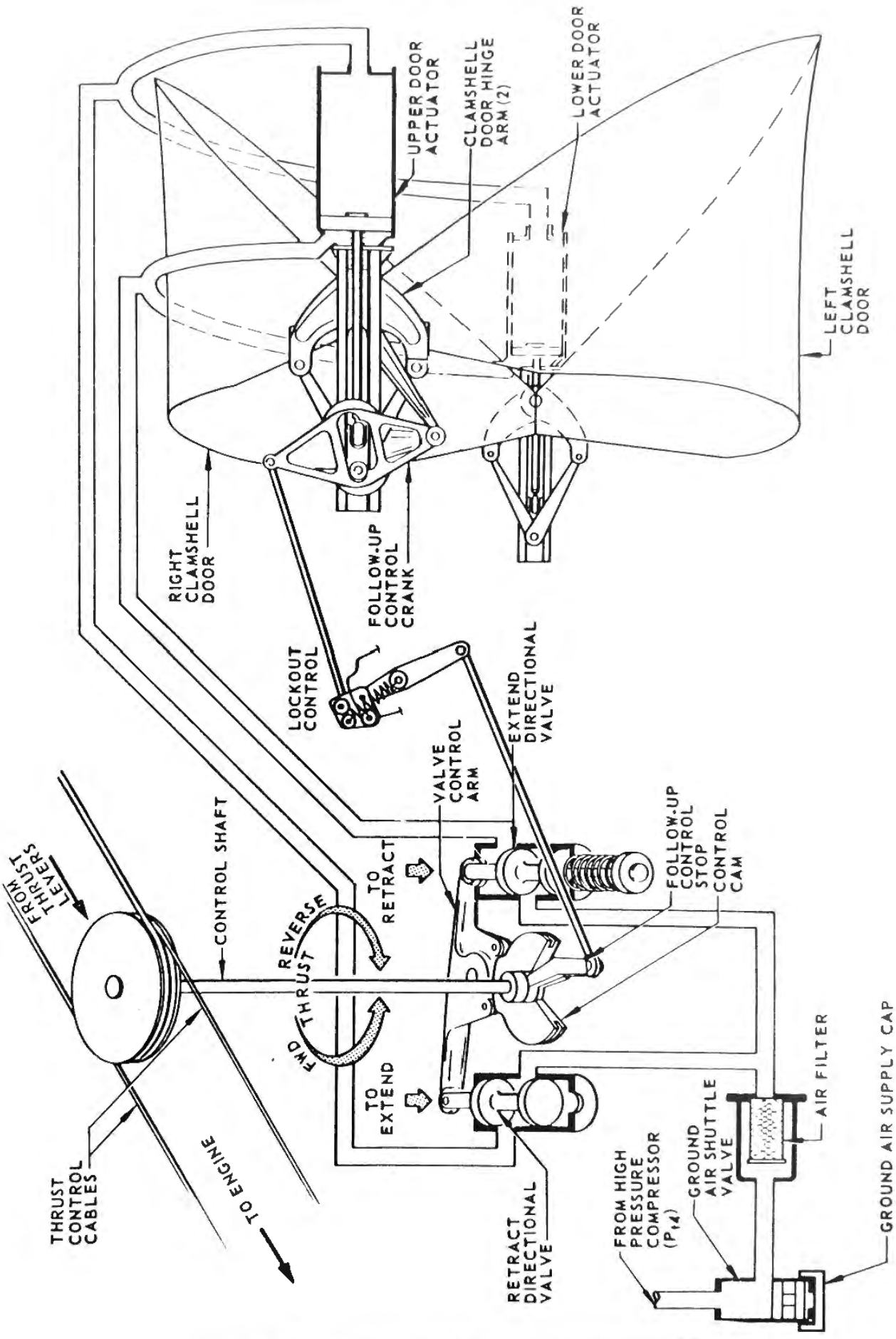
5. Clamshell Door Actuators

A. The clamshell door actuators open and close the clamshell doors by actuating the door hinge arms. The actuators consist of the actuator housing and guide track assembly. (See figure 2.) The guide track contains a truck mechanism which operates the follow-up control crank. Both actuators are identical except for the follow-up control crank installed on the upper door actuator guide track assembly. The door actuators, installed on the thrust reverser over the door hinges, are connected to the hinge arms by a pair of actuator links. For forward thrust operation, pneumatic pressure enters the head port of the actuator forcing the rod and truck assembly to move towards the forward end of the guide track. The truck pulls the door hinge arms together, thus opening the doors. For reverse thrust operation, pneumatic pressure enters the rod port of the actuator and reverses the operation to close the doors.

6. Miscellaneous Control System Components

A. Ground Air Shuttle Valve

(1) A ground air shuttle valve isolates the control system from the bleed air pressure source during ground operation. (See figure 3.) A normally capped ground air service connection is provided on this valve. The valve is located in the engine bleed air pressure line at the lower left side of the engine just forward of the thrust reverser.



Thrust Reverser Control System Schematic
Figure 3

B. Air Filter

(1) An air filter is provided to prevent contamination of the pneumatic system. (See figure 3.) The screen in the filter can be removed for cleaning or replacement. The air filter is located in the engine bleed air pressure line near the ground air shuttle valve.

7. Operation

A. The thrust reverser control system is actuated and controlled entirely by use of the reverse thrust lever. Pneumatic pressure is normally supplied from the engine high pressure compressor (P_{t4}). During ground tests, an external air source may be connected to the shuttle valve in the engine high pressure line.

B. Normally, during forward thrust operation, the control cam holds the retract directional valve open. (See figure 3.) If the clamshell doors close to the reverse thrust position during forward thrust operation, the lockout control will move the follow-up control stop and force the control cam to the 15 per cent thrust position.

C. For reverse thrust operation, the forward thrust lever must be returned to idle before the reverse thrust lever can be moved more than 12° from the idle position. This prevents accidental actuation of the clamshell doors during forward thrust operation. Initial movement of the reverse thrust lever to the 15% thrust condition (60° travel of the reverse thrust lever) positions the control cam so that the retract directional valve closes and the extend directional valve opens. The follow-up control stop on the control cam prohibits further movement of the reverse thrust lever until the clamshell doors begin to approach a fully closed position. As the doors approach the full reverse thrust position, the control crank changes the position of the lockout control to the reverse thrust position. The lockout control in turn moves the follow-up control stop on the control cam allowing the reverse thrust lever to be moved toward the maximum reverse thrust position. Returning the reverse thrust lever to idle will change the relative position of the directional valves and return the system to forward thrust operation.

D. In the event that the clamshell doors open during reverse thrust operation, the control crank disrupts the position of the lockout control. The lockout control moves the follow-up control stop and forces the control cam back to the 15 per cent engine thrust position. This sequence of steps will also occur should the doors close during forward thrust operation. Should any part of the valve control linkage fail, thus making it impossible to control the directional valves, a spring located on the extend directional valve will hold the valve closed and prevent the doors from closing. The doors are hinged forward of the center of pressure so that the force of the exhaust blast is sufficient to hold them open.

THRUST REVERSER CONTROL SYSTEM - TROUBLE SHOOTING

1. General

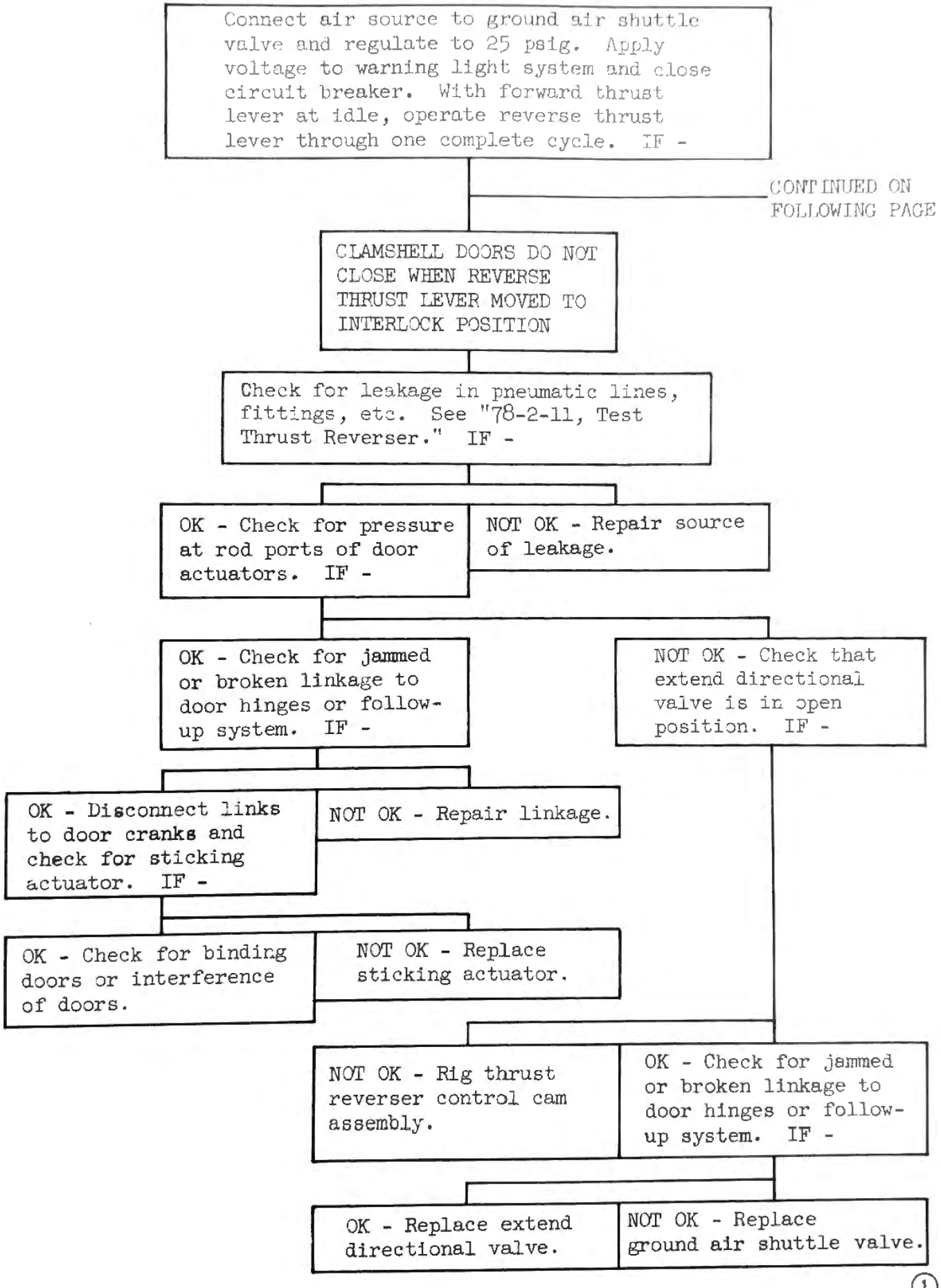
A. Trouble shooting can be performed on the thrust reverser control system without operating the engines. An external air source is used for operating the system. Caution must be exercised when operating the system with an external air source to avoid violent operating speeds. The thrust reverser warning light system can be activated to provide indication of the clamshell door position. (Refer to "Thrust Reverser Position Indication System.")

NOTE: Volume capacity of air source is important. Therefore, minimum ground air line size should be equivalent to normal thrust reverser pressure line. The gage should be located close to the ground connection shuttle valve.

B. Equipment

(1) Air pressure source - 200 psig capacity.

2. Thrust Reverser Control System Trouble Chart



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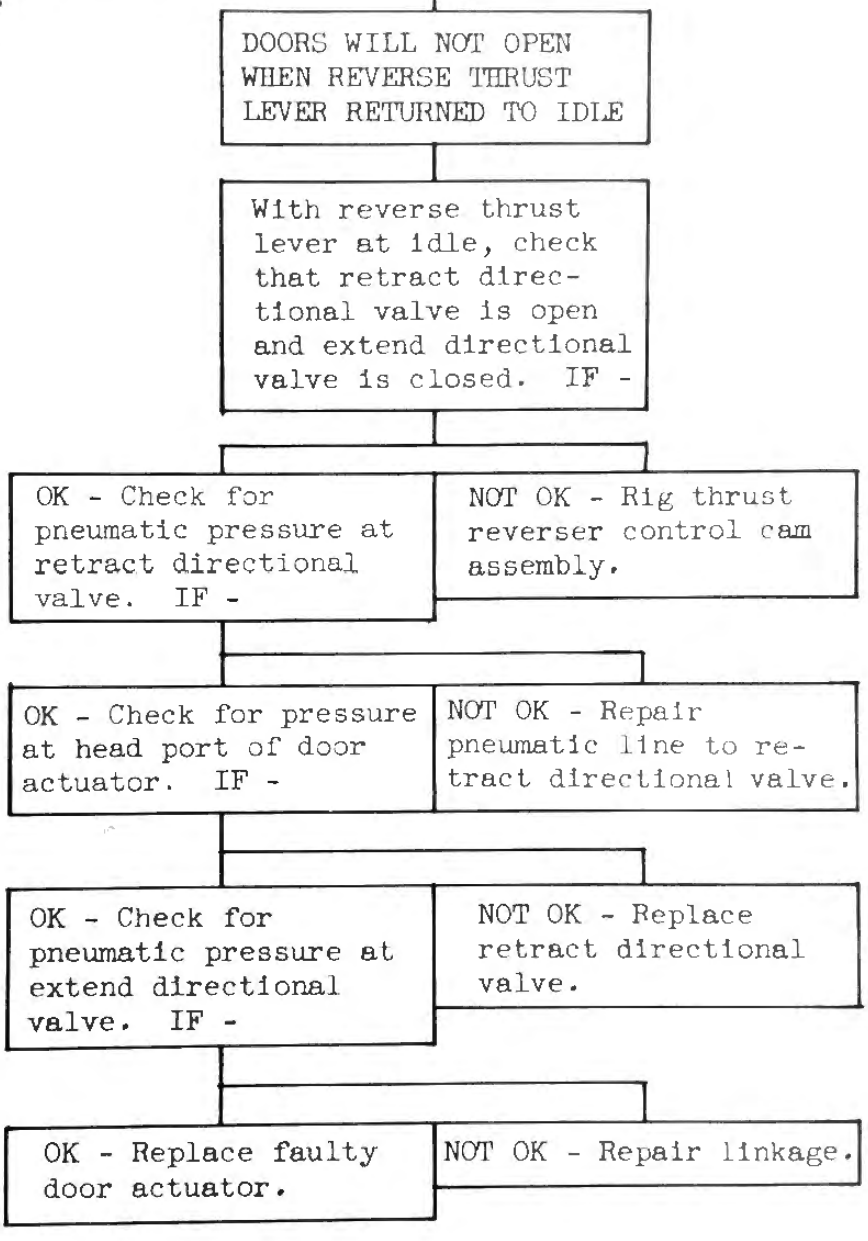


THRUST REVERSER CONTROL SYSTEM - MAINTENANCE PRACTICES

1. Adjustment/Test Thrust Reverser Control System

A. General

(1) The thrust reverser control system may be tested without operating the engines. An external air source capable of supplying a pressure of 200 psig is satisfactory for operating the system. Caution must be exercised when operating the system with an external air source to avoid violent operating speeds. The thrust reverser warning light system may be activated to provide indication of the clamshell door position. (Refer to "Thrust Reverser Position Indicating System.")

B. Special Tools and Equipment

(1) 200 psig clean, dry air source

(2) Protractor Assembly - F70024 or equivalent

(3) Spring scale - 0 to 50 pounds capacity

C. Test Thrust Reverser Control System

(1) Open left nacelle cowl panel.

(2) Place forward and reverse thrust levers at idle.

(3) Apply 25 psig pressure at the P_{t4} ground service connection, located at lower left side of thrust reverser. Check that doors remain open.

NOTE: Volume capacity of air source is important. Therefore, minimum ground air line size should be equivalent to normal thrust reverser pressure line. The gage should be located close to the ground connection shuttle valve.

(4) Move reverse thrust lever to interlock position. (60 degrees of lever movement or approximately 15% thrust condition.)

(5) Check that doors close in less than 2 seconds time. (Doors may actuate before interlock position is reached.)

(6) Move reverse thrust lever to maximum thrust position and return to 60° lever position. Check that doors remain closed during entire cycle.

(7) Continue travel of reverse thrust lever forward to approximately 25° from idle position. Check that doors have opened in less than 2 seconds time.

(8) Remove air pressure from system.

(9) Actuate reverse thrust lever aft to interlock position.

(10) Apply 50 pound load to lever knob centerline in aft direction. Check that follow-up control stop resists load.

(11) Return reverse thrust lever to idle.

(12) Repeat step (3).

(13) Move reverse thrust lever to interlock position. Check that doors have moved to reverse thrust position.

(14) Relieve air pressure on system.

(15) Return reverse thrust lever to idle.

(16) Apply 50 pound load to forward thrust lever knob centerline in forward direction. Check that follow-up control stop on control cam resists load and lever travels no more than 15° from idle.

(17) Restore air pressure to the system. Doors shall move to forward thrust position.

(18) Remove test equipment and re-cap P_{t4} connection point.

(19) Close left nacelle cowl panel.

END

(19) Relieve air pressure on system.

(20) Return reverse thrust lever to idle.

(21) Apply 50 pound load to forward thrust lever knob centerline in forward direction. Check that follow-up control stop on control cam resists load and lever travels no more than 15° from idle.

(22) Repeat step "3".

(23) Remove test equipment and re-cap P_{t4} connection point.

(24) Install engine cowl panels.

END

THRUST REVERSER CONTROL CAM ASSEMBLY - MAINTENANCE PRACTICES

1. Removal/Installation Control Cam Assembly

A. General

(1) The control cam, follow-up control stop, valve control arm, directional valves and control bracket may be removed as an assembly.

B. Remove Control Cam Assembly

(1) Remove nacelle cowl panels.

(2) Remove nacelle auxiliary fairings. See Access Doors and Panels, Chapter 12.

(a) Remove fairing 761 on outboard engines.

(b) Remove fairing 727 on inboard engines.

(3) Disconnect pneumatic lines from valve fittings (1, figure 201).

(4) Disconnect section of thrust reverser tubing underneath control cam assembly at tee connection and flexible hose connection.

(5) Disconnect rod assembly (5) from follow-up control stop (8).

(6) Remove control crank (9) by removing nut and washers from lower end of control shaft (15).

(7) Remove access panel on strut.

(a) On inboard strut, remove panel 707.

(b) On outboard strut, remove panel 741.

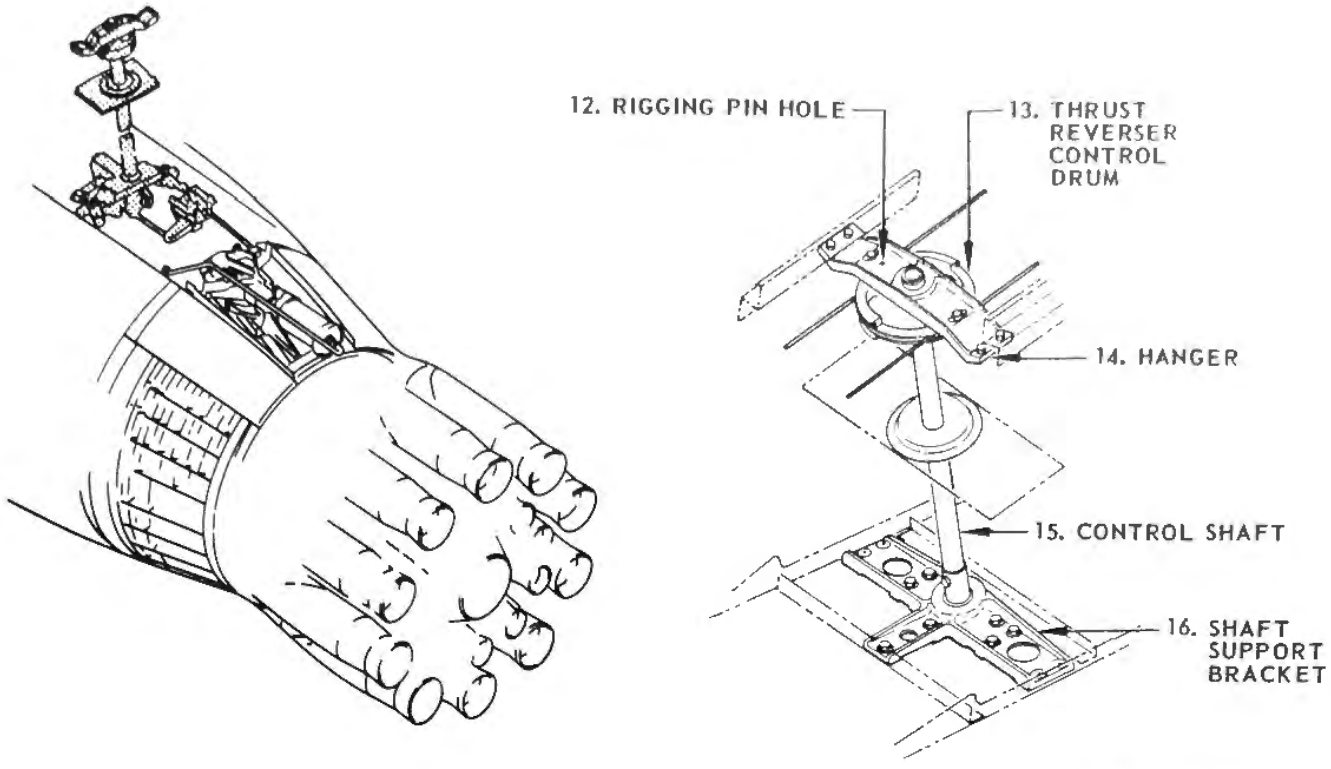
(8) Remove bolts holding control cam assembly bracket (3) to structure and pull control cam assembly off shaft.

C. Install Control Cam Assembly

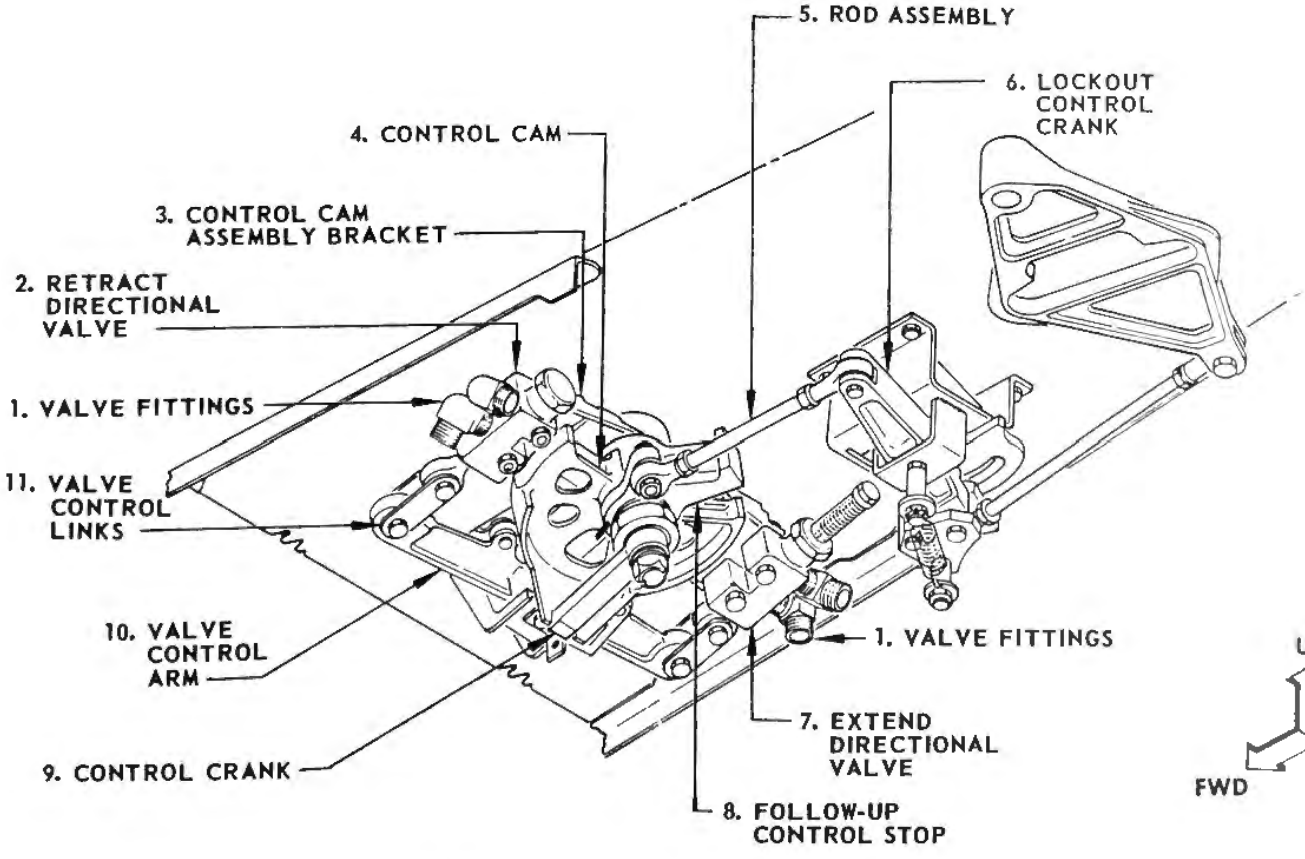
(1) Slip control cam assembly on to control shaft (15, figure 201) and install bolts holding control cam assembly bracket (3) to structure.

(a) Install two bolts forward of control cam assembly with bolt heads up.

(b) Install remaining bolts with bolt heads down.



CONTROL SHAFT INSTALLATION



Control Cam Assembly Installation
Figure 201

(2) Position spacer and control crank (9) on end of control shaft. Forward end of control crank to be in slot in control cam (4).

(3) Install washers and nut on end of control shaft. Install largest washer next to control crank. Install cotter pin on nut.

(4) Install AN395 rigging pin or AN5 bolt through thrust reverser control drum (13) and hanger (14).

(5) Connect rod assembly (5) from lockout control crank (6) to follow-up control stop (8).

(a) Position bolt pointing down through follow-up control stop.

(b) Position spacer on bolt.

(c) Install bolt through rod assembly end.

(d) Install spacer.

(e) Install bearing retainer with convex side next to spacer.

(f) Install washer and nut.

(g) Torque nut at 50 to 70 pound-inches.

(h) Install cotter pin.

(6) Adjust rod assembly (7, figure 202) between lockout control crank (9) and follow-up control stop (8) to give 1.03 (± 0.01) inches clearance between follow-up control stop and control cam.

(7) Torque check nuts on rod assembly at 60 to 85 pound-inches.

(8) Remove rigging pin from thrust reverser control drum and install access panel.

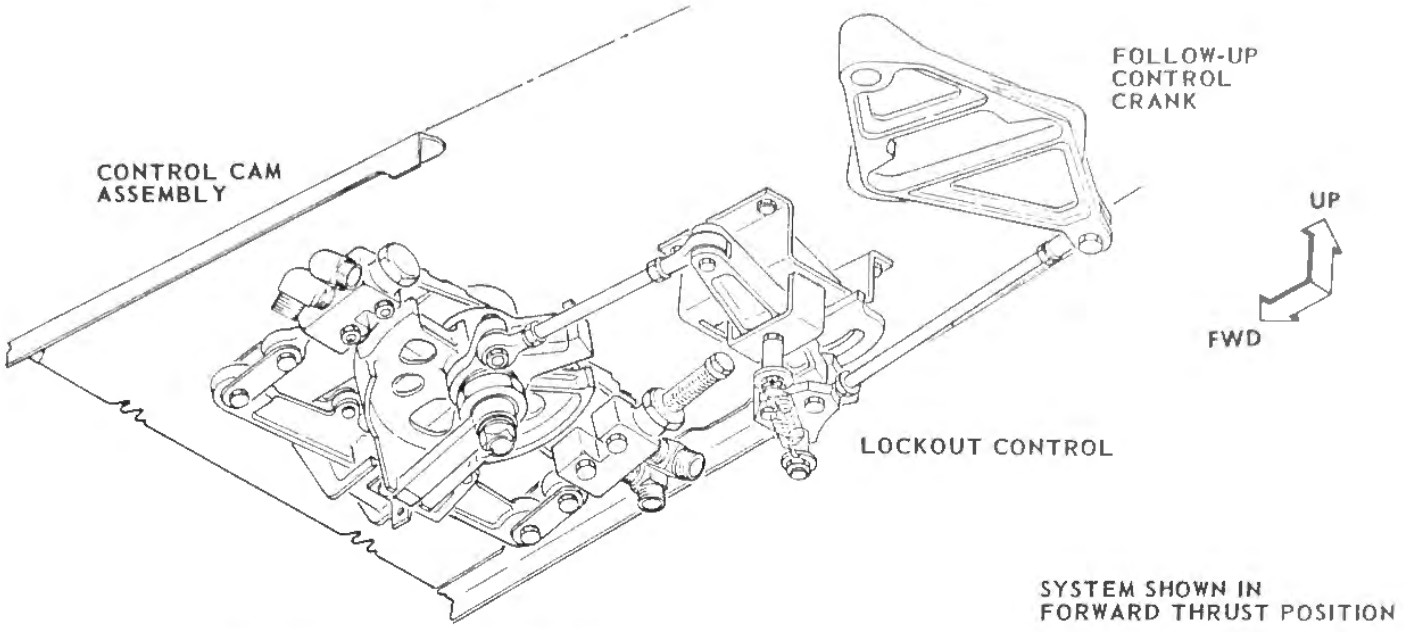
(9) Connect pneumatic line to directional valve fittings.

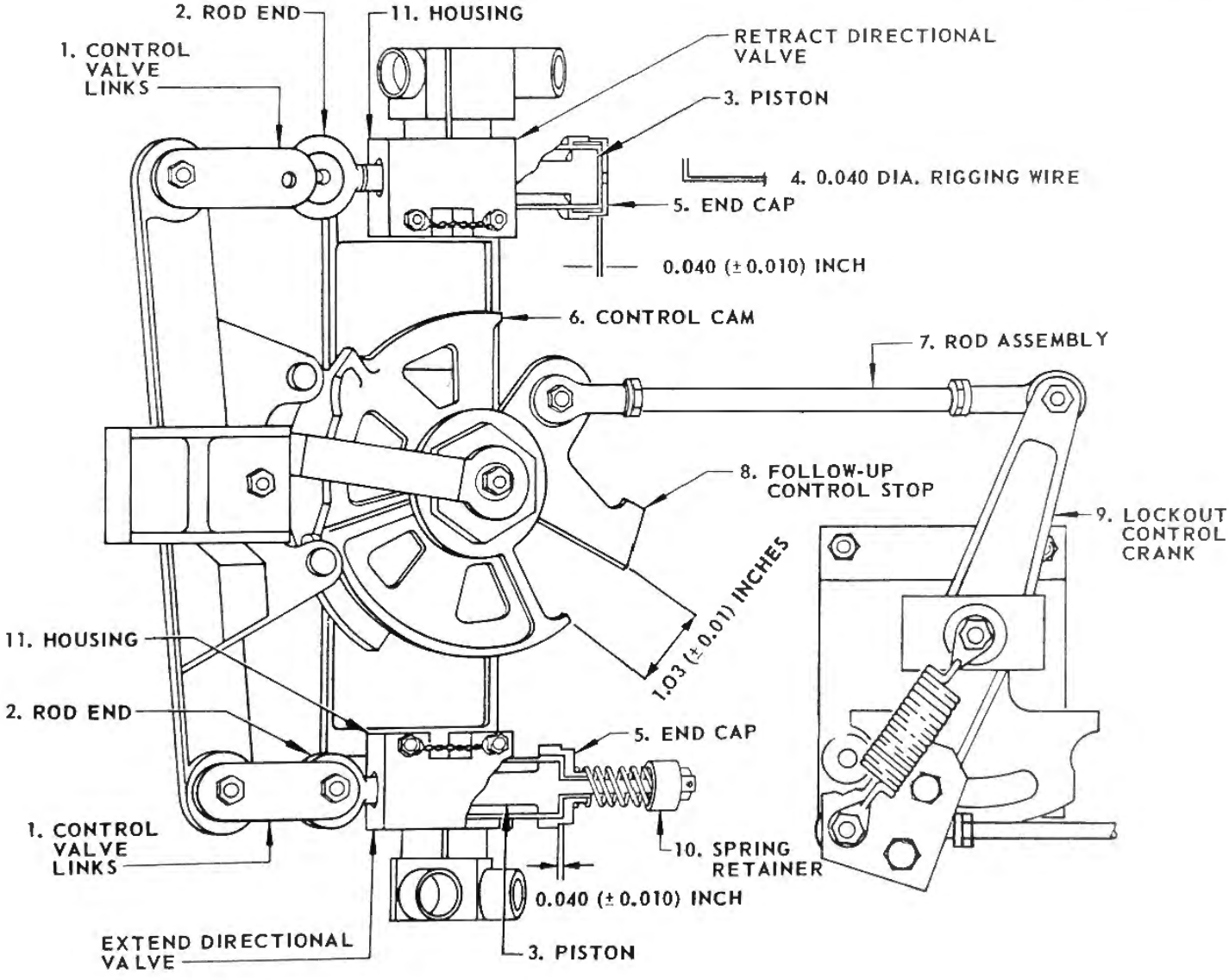
(10) Connect section of thrust reverser tubing underneath control cam assembly at tee connection and flexible hose connection.

(11) Install nacelle auxiliary fairings. See Access Doors and Panels, Chapter 12.

(a) Install fairing 761 on outboard engines.

(b) Install fairing 727 on inboard engines.





Control Cam Assembly Rigging
Figure 202

2. Removal/Installation Extend Directional Valve

A. Remove Extend Directional Valve

(1) Remove nacelle cowl panels.

(2) Remove nacelle auxiliary fairings.

(3) Disconnect pneumatic lines from valve fittings (1, figure 201).

(4) Disconnect valve control links (11) at valve rod end.

(5) Remove valve housing mounting bolts and remove valve assembly.

B. Install Extend Directional Valve

(1) Install new directional valve by installing valve housing mounting bolts. Lockwire bolts.

(2) Adjust rod end (2, figure 202) to give specified clearance between valve piston (3) and valve end cap (5).

(a) Measure distance between outside face of valve end cap and nut side of spring retainer (10).

(b) Operate control cam to the valve closed position by placing reverse thrust lever in idle.

(c) Adjust valve rod end to give a 0.040 (± 0.010) inch difference in dimension from step (a) and when hole in rod end bearing is in alignment with holes in control links.

(d) Temporarily install bolt through control links and rod end bearing. Measure distance between outside face of valve end cap and nut side of spring retainer. Check that a difference of 0.040 (± 0.010) inch is obtained between (a) and (d).

(3) Connect rod end to control links with a thin washer on each side of rod end. Install thick washer and nut on bottom side.

(4) Operate control cam to the valve open position so valve rod end check nut clears housing (11). Tighten rod end check nut at 10 to 20 pound-inches and bend tabs of tab washer to valve piston and nut.

(5) Connect pneumatic lines to valve fittings.

(6) Install nacelle auxiliary fairings.

(a) Install fairing 761 on outboard engines.

(b) Install fairing 727 on inboard engines.

(7) Install nacelle cowl panel.

3. Removal/Installation Retract Directional Valve

A. Remove Retract Directional Valve

(1) General

(a) In order to perform rigging of the retract directional valve after installation, it is necessary to adjust valve rod end so that valve piston is 0.040 (± 0.010) inches from valve end cap when valve is fully closed. (The control cam is in the reverse thrust position.) (See figure 202.) This can be accomplished satisfactorily by bending a small hook approximately 1/8 inches long at the end of a piece of 0.040 inch diameter lockwire and at 90 degrees to it. The bent end of the lockwire can then be inserted into hole in valve end cap and oriented so valve piston bottoms on hook.

(2) Remove nacelle cowl panels.

(3) Remove nacelle auxiliary fairings. See Access Doors and Panels, Chapter 12.

(a) Remove fairing 761 on outboard engines.

(b) Remove fairing 727 on inboard engines.

(4) Disconnect pneumatic lines from valve fittings.

(5) Disconnect valve control links (11) at valve rod end.

(6) Remove valve housing mounting bolts and remove valve assembly.

B. Install Retract Directional Valve

(1) Install new directional valve by installing valve housing mounting bolts. Lockwire bolts.

(2) Adjust rod end (2,figure 202) to give specified clearance between valve piston (3) and valve end cap (5).

(a) Operate control cam to valve closed position by moving reverse thrust lever to interlock position.

(b) Install hook end of rigging wire (4) into hole in end cap and bottom piston against wire.

(c) Hold piston against wire and adjust valve rod end so attachment hole in rod end aligns with holes in control links.

(3) Connect rod end to control links with thin washers at each side of rod end. Install thick washer and nut on bottom side. Remove lockwire from hole.

(4) Return reverse thrust lever to idle so valve rod end check nut clears housing (11).

(5) Tighten rod end check nut at 10 to 20 pound-inches and bend tabs of tab washer to valve piston and nut.

(6) Connect pneumatic lines to valve fittings.

(7) Install nacelle auxiliary fairing.

(a) Install fairing 761 on outboard engines.

(b) Install fairing 727 on inboard engines.

(8) Install nacelle cowl panels.

4. Adjustment/Test Control Cam Assembly

A. Adjust Control Cam Assembly

(1) Remove nacelle cowl panels.

(2) Remove nacelle auxiliary fairings. See Access Doors and Panels, Chapter 12.

(3) Remove access panel on strut.

(a) On inboard struts, remove nacelle strut access panel 707.

(b) On outboard struts, remove nacelle strut access panel 741.

(4) Install AN395 rigging pin, or AN5 bolt through thrust reverser control drum (13, figure 201) and hanger (14).

(5) Adjust rod assembly (7, figure 202) between lockout control crank (9) and follow-up control stop (8) to give 1.03 (± 0.01) inches dimension between follow-up control stop and control cam (6).

(6) Torque check nut on rod assembly at 60 to 85 pound-inches.

(7) Remove rigging pin from thrust reverser control drum and install access panel.

(8) Install nacelle auxiliary fairing.

(9) Install nacelle cowl panels.

5. Approved Repair Control Cam Assembly

A. Equipment and Materials

(1) Wrench Adapter - F70068 or equivalent

B. Replace Control Shaft Bearing

(1) Remove control cam assembly. See "Removal/Installation Control Cam Assembly."

(2) Loosen set screw in shaft support bracket. (See figure 203.)

(3) Using wrench adapter, remove nuts which hold bearing.

(4) Push bearing downward to remove it from opening in shaft support bracket.

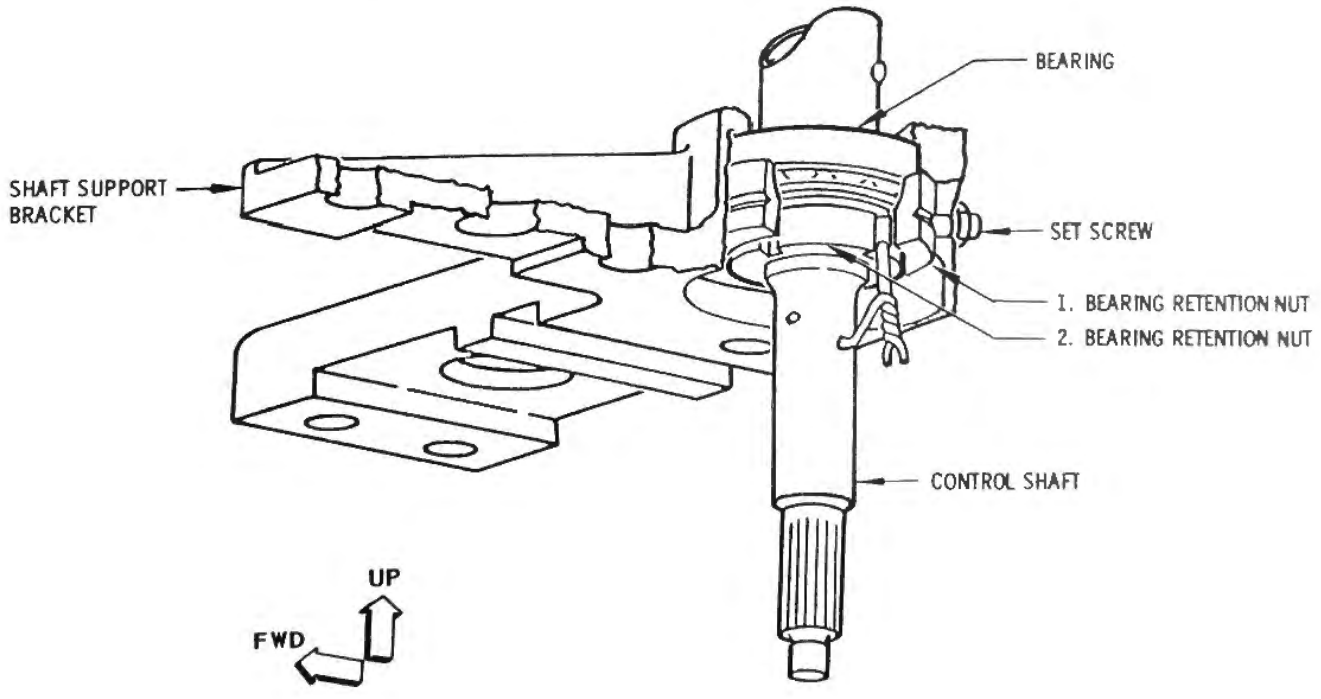
(5) Position new bearing in shaft support bracket.

(6) Install bearing retention nuts (1) and (2) to secure bearing. Tighten nut (1) within torque range of 170 to 200 pound-inches.

(7) Lockwire lower nut to shaft.

(8) Tighten set screw in shaft support bracket.

(9) Install control cam assembly. See "Removal/Installation Control Cam Assembly."



Control Shaft Bearing Installation
Figure 203

THRUST REVERSER LOCKOUT CONTROL - MAINTENANCE PRACTICES

1. Removal/Installation Thrust Reverser Lockout Control

A. Equipment

(1) Spring scale - 0 to 30 pounds capacity

B. Remove Thrust Reverser Lockout Control

(1) Remove nacelle cowl panels.

(2) Remove nacelle auxiliary fairing. See Access Doors and Panels, Chapter 12.

(a) Remove fairing 761 on outboard engines.

(b) Remove fairing 727 on inboard engines.

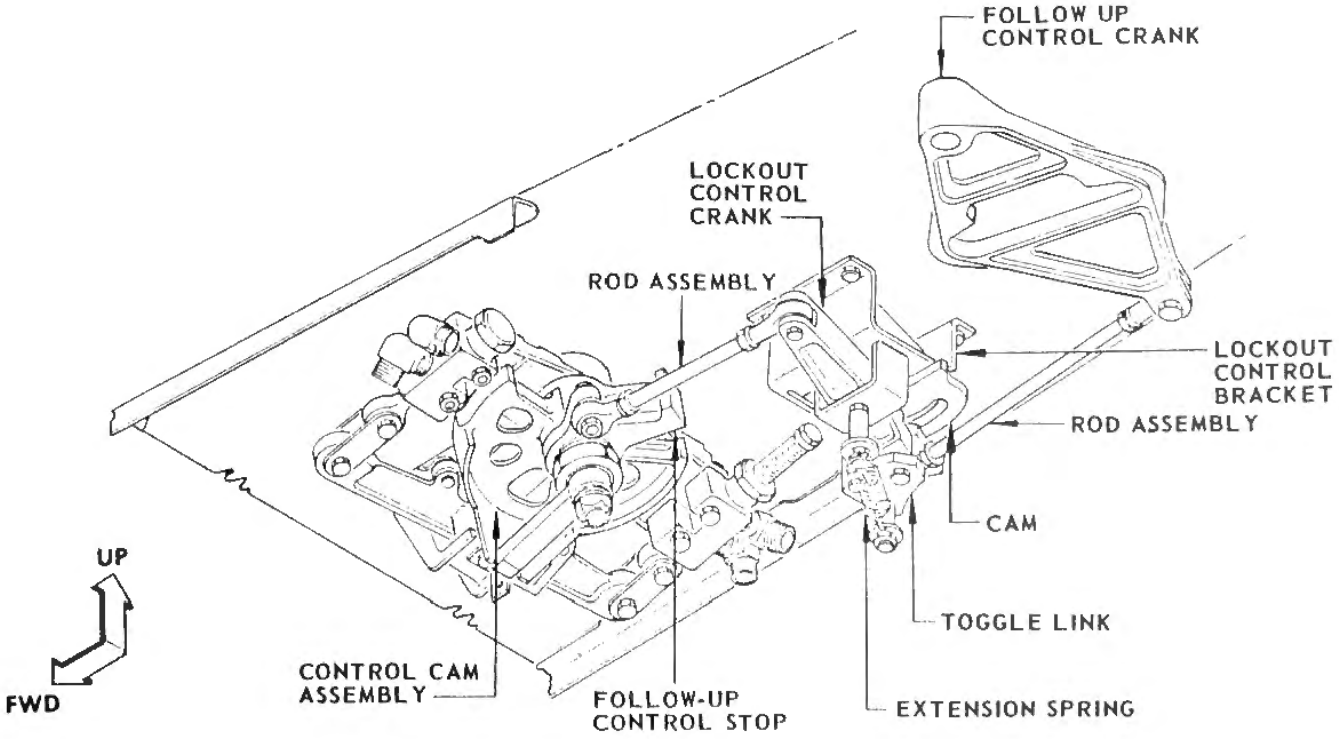
(3) Disconnect both rod assemblies from lockout control. (See figure 201.)

(4) Remove access panel on strut.

(a) On inboard strut, remove panel 707.

(b) On outboard strut, remove panel 741.

(5) Remove lockout control by removing bolts from bracket.



Lockout Control Installation
Figure 201

C. Install Thrust Reverser Lockout Control

(1) Position lockout control and install mounting bolts in lockout control bracket. (See figure 201.) Install nuts on bottom side of bracket.

(2) Connect rod assembly from follow-up control stop to lockout control crank.

(a) Position bearing retainer on each side of rod assembly end.

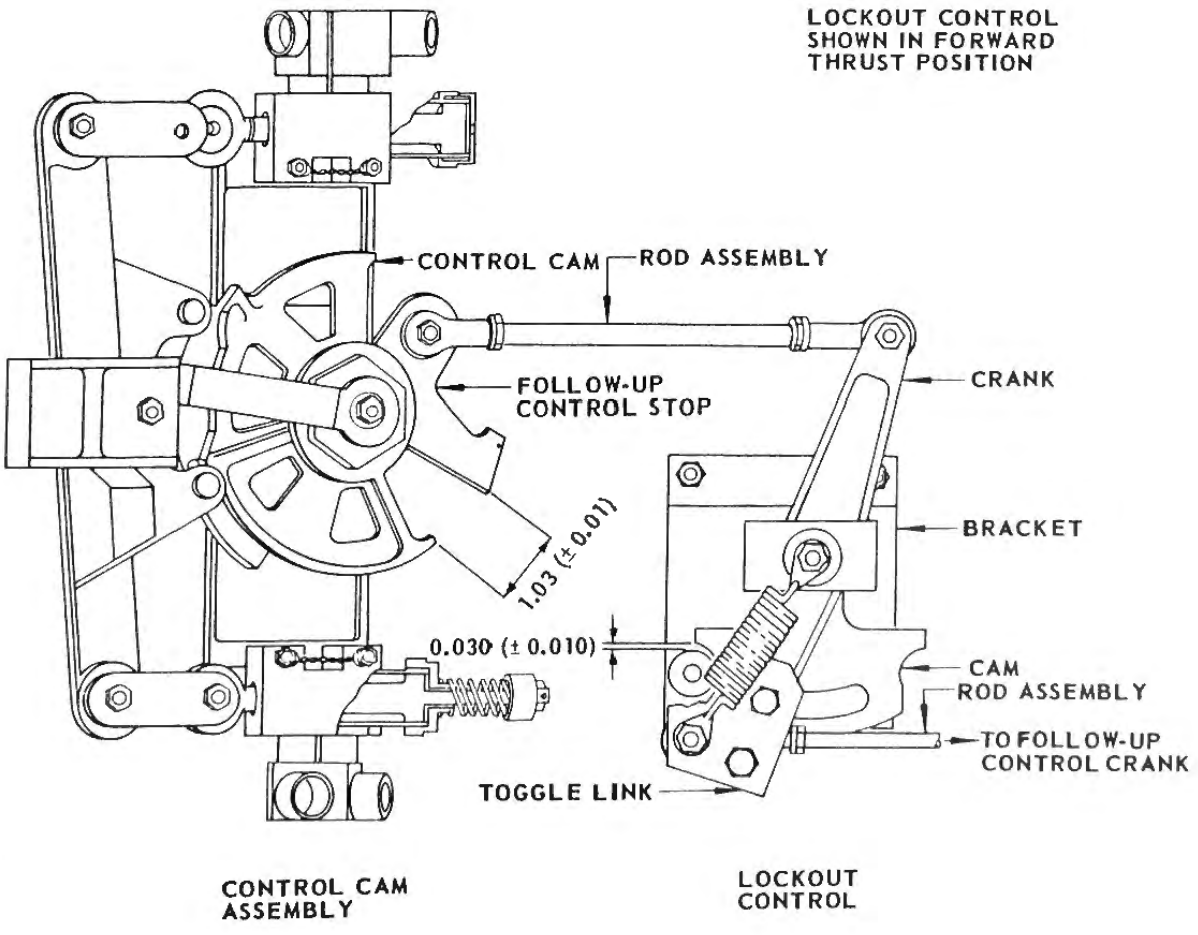
(b) Position bolt pointing down through lockout control crank and rod end.

(c) Install washer and nut.

(3) Install AN395 rigging pin or AN5 bolt through thrust reverser control drum and hanger. Refer to 78-3-1, figure 201.

(4) Move lockout control to forward thrust position. (See figure 202.)

(5) Adjust rod assembly from follow-up control stop to lockout control crank to give a 1.03 (± 0.01) inches dimension between follow-up control stop and control cam (See figure 202.)



Thrust Reverser Lockout Control Rigging
Figure 202

(6) Torque check nuts on rod assembly at 60 to 85 pound-inches.

(7) Remove rigging pin from thrust reverser control drum and install an access panel.

(8) Connect rod assembly from follow-up control crank to lockout control.

(a) Position large washer on each side of rod end.

(b) Install bolt pointing down through toggle link and rod end.

(c) Install long spacer on bolt.

(d) Install small washer.

(e) Install short spacer.

(f) Install spring retainer.

(g) Install small washer.

(h) Install bolt and cotter pin.

(9) Apply 5 to 30 pound force in aft direction at rod assembly end fitting on follow-up control crank. (See figure 201.)

(10) Adjust rod assembly to give 0.030 (± 0.010) inch clearance between forward roller and lockout control cam surface (figure 202). Adjust rod with engine at ambient (atmospheric) temperature.

(11) Torque check nuts at 60 to 85 pound-inches.

(12) Install nacelle auxiliary fairings. See Access Doors and Panels, Chapter 12.

(a) Install fairing 761 on outboard engines.

(b) Install fairing 727 on inboard engines.

(13) Install nacelle cowl panels.

2. Adjustment/Test Thrust Reverser Lockout Control

A. General

(1) The lockout control is rigged in forward thrust position and with engine at ambient (atmospheric) temperature.

B. Equipment and Materials

(1) Spring Scale - 0 to 30 pound capacity.

C. Rig Thrust Reverser Lockout Control

(1) Remove nacelle cowl panels.

(2) Remove nacelle auxiliary fairing. See Access Doors and Panels, Chapter 12.

(a) Remove fairing 761 on outboard engines.

(b) Remove fairing 727 on inboard engines.

(3) Manually position clamshell doors in forward thrust position.

(4) Apply a 5 to 30 pound force in aft direction at rod assembly end fitting on follow-up control crank (figure 201).

(5) Adjust rod assembly between follow-up control crank and lockout control to give 0.030 (± 0.010) inch clearance between forward roller and lockout control cam surface. (See figure 202.)

(6) Torque check nuts on rod assembly at 60 to 85 pound-inches.

(7) Install nacelle auxiliary fairing.

(a) Install fairing 761 on outboard engines.

(b) Install fairing 727 on inboard engines.

(8) Install nacelle cowl panels.

END

CLAMSHELL DOOR ACTUATORS - MAINTENANCE PRACTICES

1. Removal/Installation Clamshell Door Actuators

A. General

(1) The installation for both the upper and lower door actuators is similar, except for the follow-up control crank mounted on the upper door actuator.

B. Equipment

(1) Air pressure source - 0 to 200 psig capacity

(2) Spring scale - 0 to 30 pound capacity (Required only if removing upper actuator)

C. Remove Door Actuator

(1) Remove engine cowl panels.

(2) If removing upper door actuator, remove nacelle aft fairing. See Access Doors and Panels, Chapter 12.

(a) Remove fairing 759 on outboard engines.

(b) Remove fairing 712 on inboard engines.

(3) If removing lower actuator, remove thrust reverser keel fairing.

(4) Remove sound suppressor fairing covering actuator cylinder.

(5) Disconnect pneumatic lines from rod and head ports of actuator. (See figure 201.)

(6) If removing upper door actuator, disconnect follow-up control crank from actuator guide track.

(7) Disconnect hinge arm links at door hinge arms.

(8) Remove bolts from track supports.

(9) Remove actuator by removing bolts holding actuator cylinder to actuator support brackets.

D. Prepare for Installation

(1) Assemble hinge arm links to actuator truck.

(a) Position bushing over bolt shank.

(b) Position bolt through hole in truck nearest thrust reverser.

(c) Position large washer over bushing.

(d) Position first hinge arm link over bushing.

(e) Position large washer over bushing.

(f) Position second hinge arm link over bushing.

(g) Position bearing over bolt.

(h) Push bolt through remaining hole in actuator truck.

(i) If installing upper actuator, position two bearings over bolt. If installing lower actuator, position one bearing over bolt.

(j) Position small washer over bearing.

(k) Install nut. Torque nut at 480 to 650 pound-inches and install cotter pin.

E. Install Door Actuator

(1) Install bolts holding guide track to track support. (See figure 201.)

(a) Install countersunk bolt from inside of track.

(b) Position bushing over bolt in track support.

(c) Install washer and nut on bolt.

(2) Position actuator cylinder between actuator support brackets and install bolts. Use shims under forward end of supports to obtain alignment of bolts.

(3) (PAA, AA N7501A thru N7513A, CAL, TWA N731TW thru N739TW, and QANTAS VH-EBA).

If installing upper actuator, install follow-up control crank to actuator guide track assembly. (See figure 201.)

(a) Position bolt through guide track with bolt shank pointing up.

(b) Position thin washer over bolt. Use washers as required to maintain a clearance of 0.01 (+0.03/-0.00) inch between upper face of guide track and lower face of follow-up control crank. Two washers are maximum that can be used.

(c) Place follow-up control crank, staked bearing downward, on bolt. Position spacer and bearing over bolt shank.

(d) Install washer and nut on bolt. Torque nut at 160 - 190 pound-inches and install cotter pin.

(4) (AA N7514A thru N7525A, TWA N740TW thru N745TW, QANTAS VH-EBB thru VH-EBG and USAF).

If installing upper actuator, install follow-up control crank to actuator guide track assembly. (See figure 202.)

(a) Position bolt through guide track with bolt shank pointing up.

(b) Position thin washer over bolt. Use washers as required to maintain a clearance of 0.01 (+0.03/-0.00) inch between upper face of guide track and lower face of follow-up control crank. Two washers are maximum that can be used.

(c) Install spacer (1) in follow-up control crank.

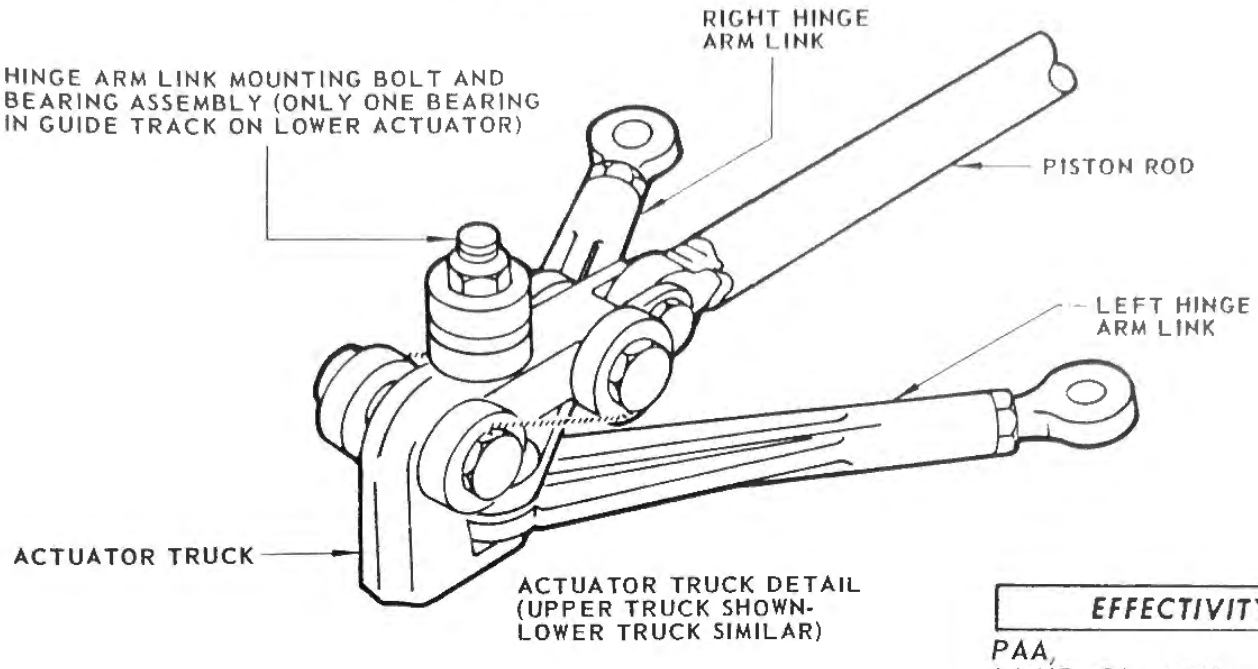
(d) Place follow-up control crank, pressed bushing downward, on bolt. Position spacer and bushing on bolt.

(e) Install washer and nut. Torque nut from 160 to 190 pound-inches. Maintain gap between washer and bushing at .02 ± .01 inches. Use AN960C816L washer or equivalent (.875 O.D., .515 I.D. x .032 Thick) if necessary in order to maintain gap.

(5) Connect pneumatic lines to rod and head ports of actuator cylinder.

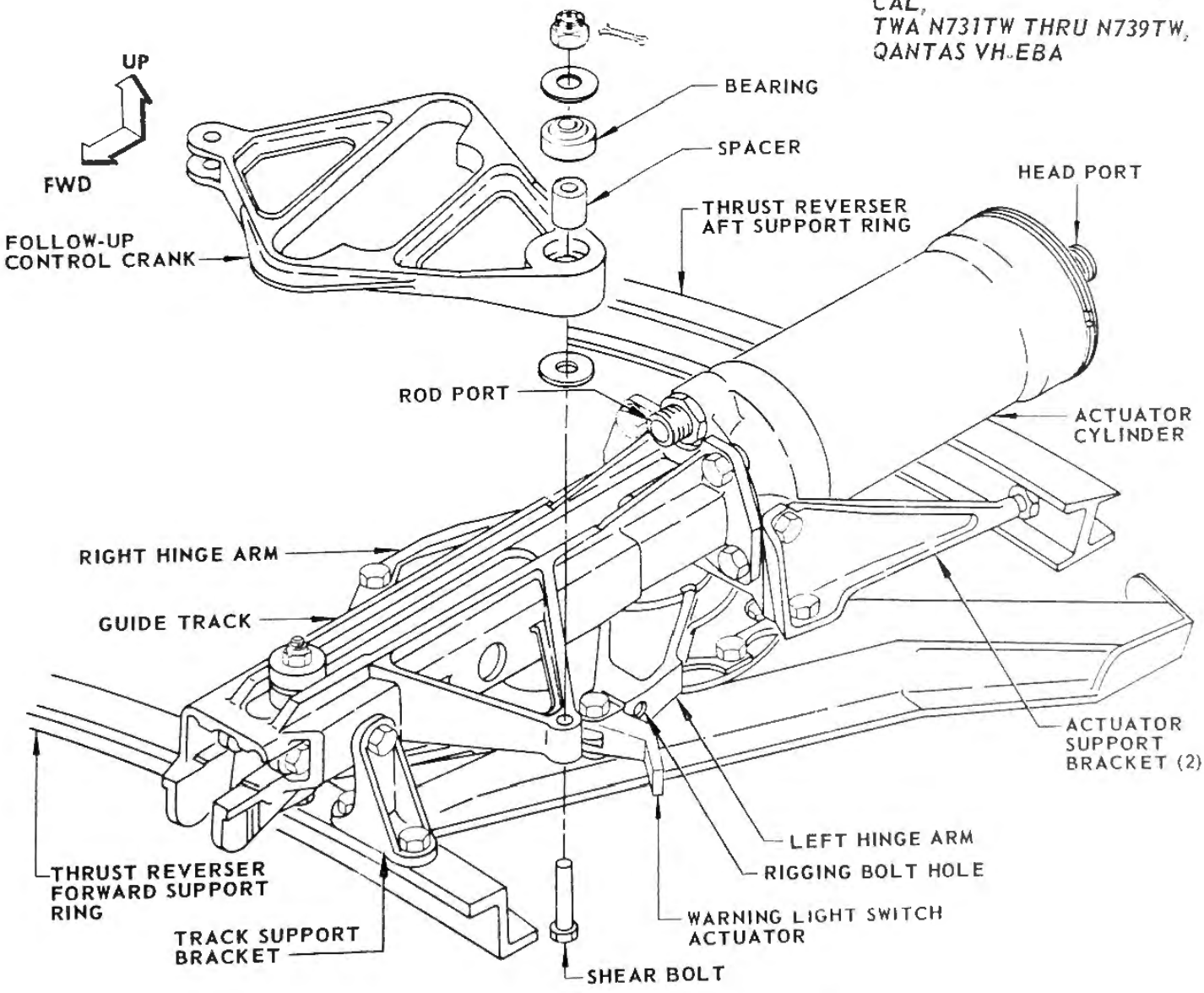
(6) Manually move doors to forward thrust position. Hold doors in forward thrust position with NAS501 rigging bolt through hinge arms. (See figure 201.)

(7) Position reverse thrust lever at idle.

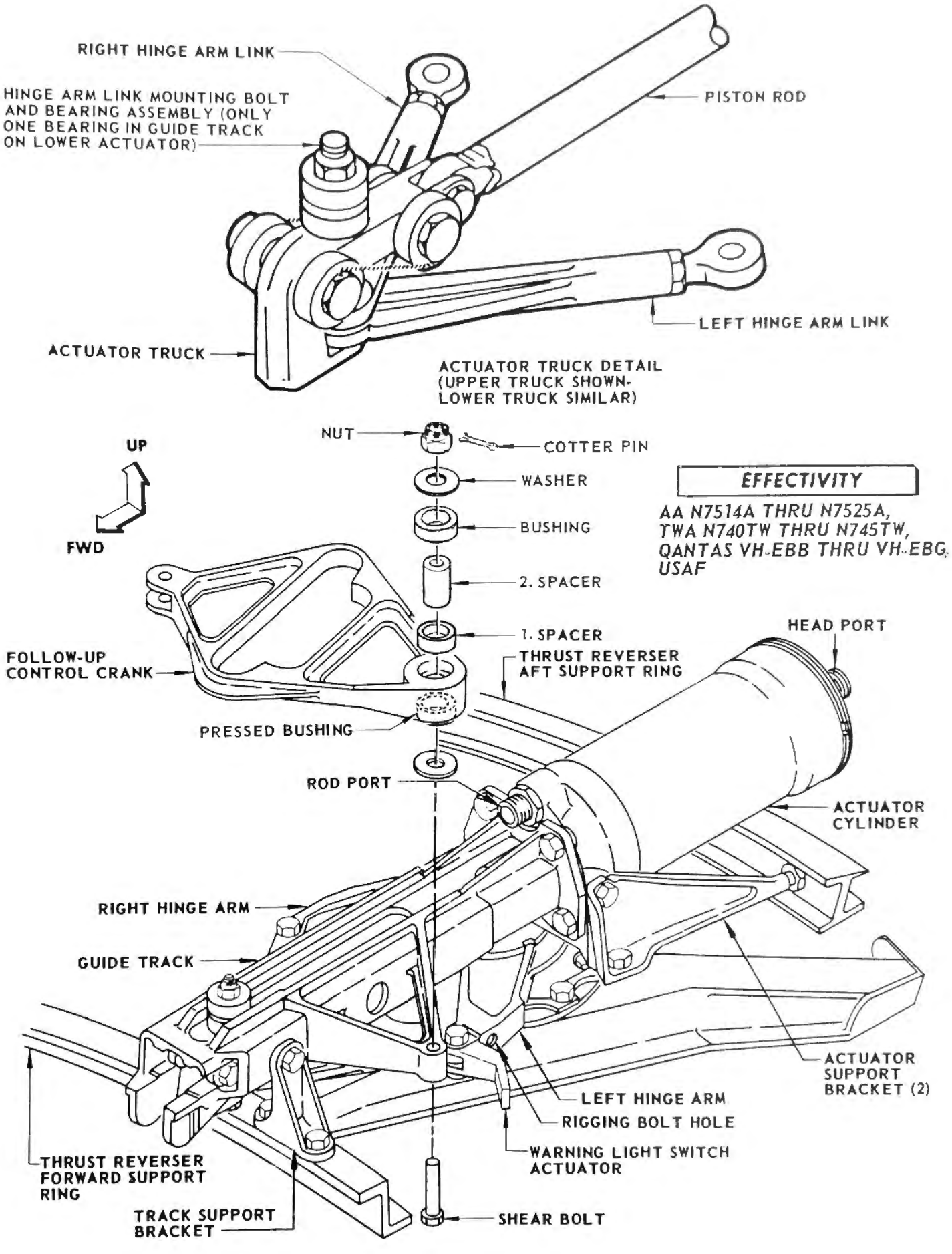


EFFECTIVITY

PAA,
AA N7501A THRU N7513A,
CAL,
TWA N731TW THRU N739TW,
QANTAS VH-EBA



Clamshell Door Actuator Installation
Figure 201


RIGHT HINGE ARM LINK
HINGE ARM LINK MOUNTING BOLT AND BEARING ASSEMBLY (ONLY ONE BEARING IN GUIDE TRACK ON LOWER ACTUATOR)
PISTON ROD
LEFT HINGE ARM LINK
ACTUATOR TRUCK
ACTUATOR TRUCK DETAIL (UPPER TRUCK SHOWN-LOWER TRUCK SIMILAR)
NUT
COTTER PIN
WASHER
BUSHING
2. SPACER
1. SPACER
UP
FWD
EFFECTIVITY
AA N7514A THRU N7525A,
TWA N740TW THRU N745TW,
QANTAS VH-EBB THRU VH-EBG,
USAF
HEAD PORT
FOLLOW-UP CONTROL CRANK
THRUST REVERSER AFT SUPPORT RING
PRESSED BUSHING
ROD PORT
ACTUATOR CYLINDER
RIGHT HINGE ARM
GUIDE TRACK
ACTUATOR SUPPORT BRACKET (2)
LEFT HINGE ARM
RIGGING BOLT HOLE
WARNING LIGHT SWITCH ACTUATOR
THRUST REVERSER FORWARD SUPPORT RING
TRACK SUPPORT BRACKET
SHEAR BOLT

(8) Connect air source to ground air service connection and regulate to 25 psig to hold pistons against internal stops. Check that all moisture is out of air hose before connecting to ground air service connection.

CAUTION: EXERCISE CARE IN APPLYING PRESSURE TO AVOID VIOLENT OPERATING SPEEDS.

NOTE: Volume capacity of air source is important. Therefore, minimum ground air line size should be equivalent to normal thrust reverser pressure line. The gage should be located close to the ground connection shuttle valve.

(9) Adjust links to fit hinge arms and tighten check nuts.

(10) Connect links to hinge arms.

(a) Position links to hinge arms and install bolts with bolt shanks pointing towards thrust reverser.

(b) Install washer, nut, and cotter pin. Install warning light switch actuator on upper left hinge arm.

(c) Install cotter pin.

(11) Disconnect air source.

(12) Remove rigging bolts.

(13) If installing upper door actuator, rig lockout control. The lockout control is rigged with the clamshell doors in the forward thrust position and with engine at ambient (atmospheric) temperature. (See figure 203.)

(a) Apply a 10 (+20/-5) pound load in the aft direction at rod assembly end fitting on follow-up control crank.

(b) Adjust rod assembly between follow-up control crank and lockout control to give 0.030 (± 0.010) inch dimension between forward roller and lockout control cam surface.

(c) Torque check nut on rod assembly after rigging at 60 to 85 pound-inches.

(14) Install sound suppressor fairing covering actuator cylinder.

(15) If installing upper door actuator, install aft nacelle fairing.

(16) If installing lower door actuator, install thrust reverser keel fairing and sound suppressor keel fairing.

(17) Install engine cowl panels.

2. Adjustment/Test Clamshell Door Actuators

A. Equipment and Materials

(1) Air pressure source - 0 to 200 psig capacity.

(2) Spring scale - 0 to 30 pound capacity (Required only when rigging upper actuator.)

B. Rig Door Actuators

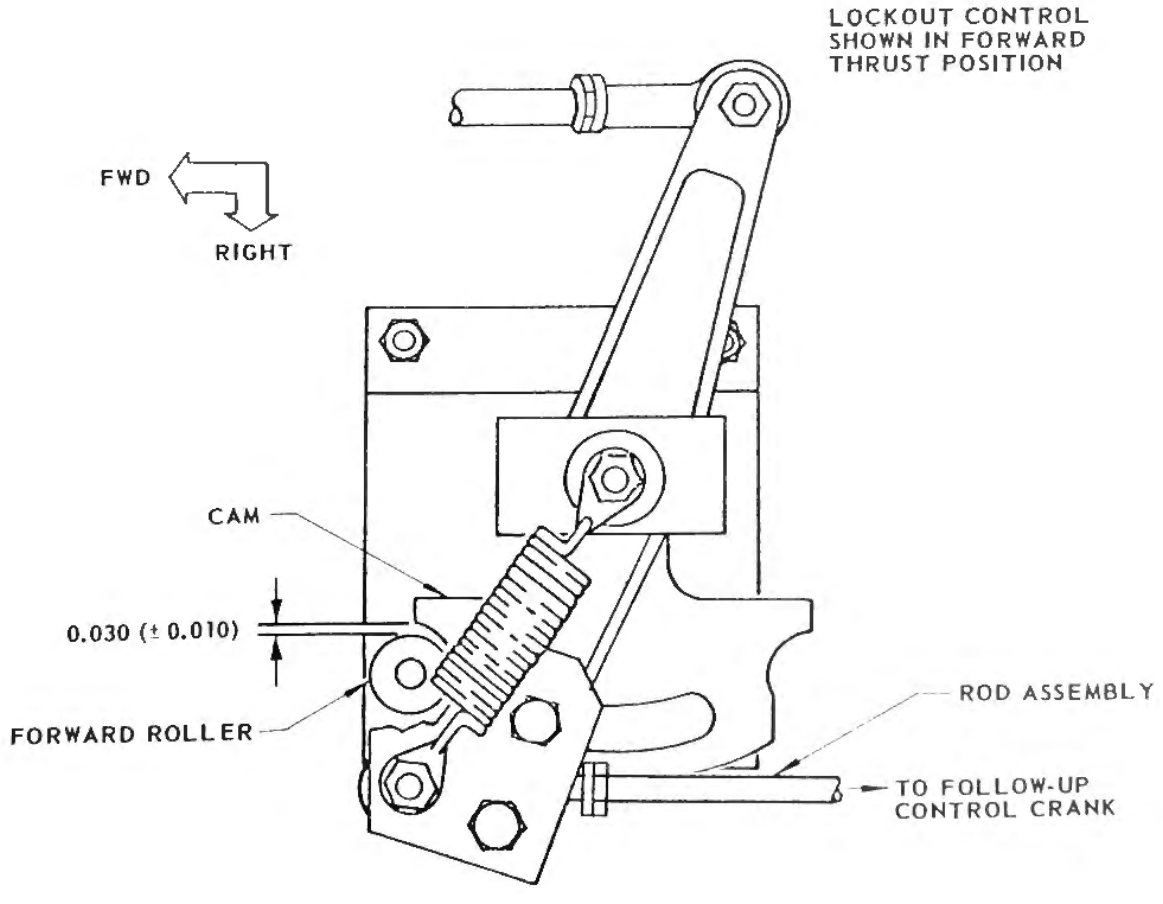
(1) Remove engine cowl panels.

(2) Remove sound suppressor fairing from door actuator cylinders.

(3) Disconnect actuator links at door hinge arms. (See figure 201.)

(4) Manually move doors to forward thrust position. Hold doors in forward thrust position with NAS501 rigging bolts through hinge arms.

(5) Position reverse thrust lever at idle.



Lockout Control Rigging
Figure 203

(6) Connect 25 psig air source to ground air service connection to hold pistons against internal stops. Check that all moisture is out of air hose before connecting to ground air service connection.

CAUTION: EXERCISE CARE IN APPLYING PRESSURE TO AVOID VIOLENT OPERATING SPEEDS.

NOTE: Volume capacity of air source is important. Therefore, minimum ground air line size should be equivalent to normal thrust reverser pressure line. The gage should be located close to the ground connection shuttle valve.

(7) Adjust links to fit hinge arms and tighten check nuts.

(8) Connect links to hinge arms.

(a) Position links on hinge arms and install bolts with bolt shanks pointing towards thrust reverser.

(b) Install washer, nut, and cotter pin.

(9) Disconnect air source.

(10) Remove rigging bolts.

(11) If rigging upper door actuator, the follow-up control crank must be adjusted with respect to the lockout control. (See figure 203.) Adjust with engine at ambient (atmospheric) temperature.

(a) Apply a 10 (+20/-5) pound load in the aft direction at rod assembly end fitting of follow-up control crank.

(b) Adjust rod assembly between follow-up control crank and lockout control to give 0.030 (± 0.010) inch dimension between forward roller and lockout control cam surface.

(c) Torque check nut on rod assembly after rigging at 60 to 85 pound-inches.

(12) Install sound suppressor fairing covering actuator cylinder.

(13) Install engine cowl panels.

3. Inspection/Check Clamshell Door Actuators

A. For upper door actuator only, check that clearance between upper face of guide track and lower face of follow-up control crank is within 0.01 to 0.04 inch.

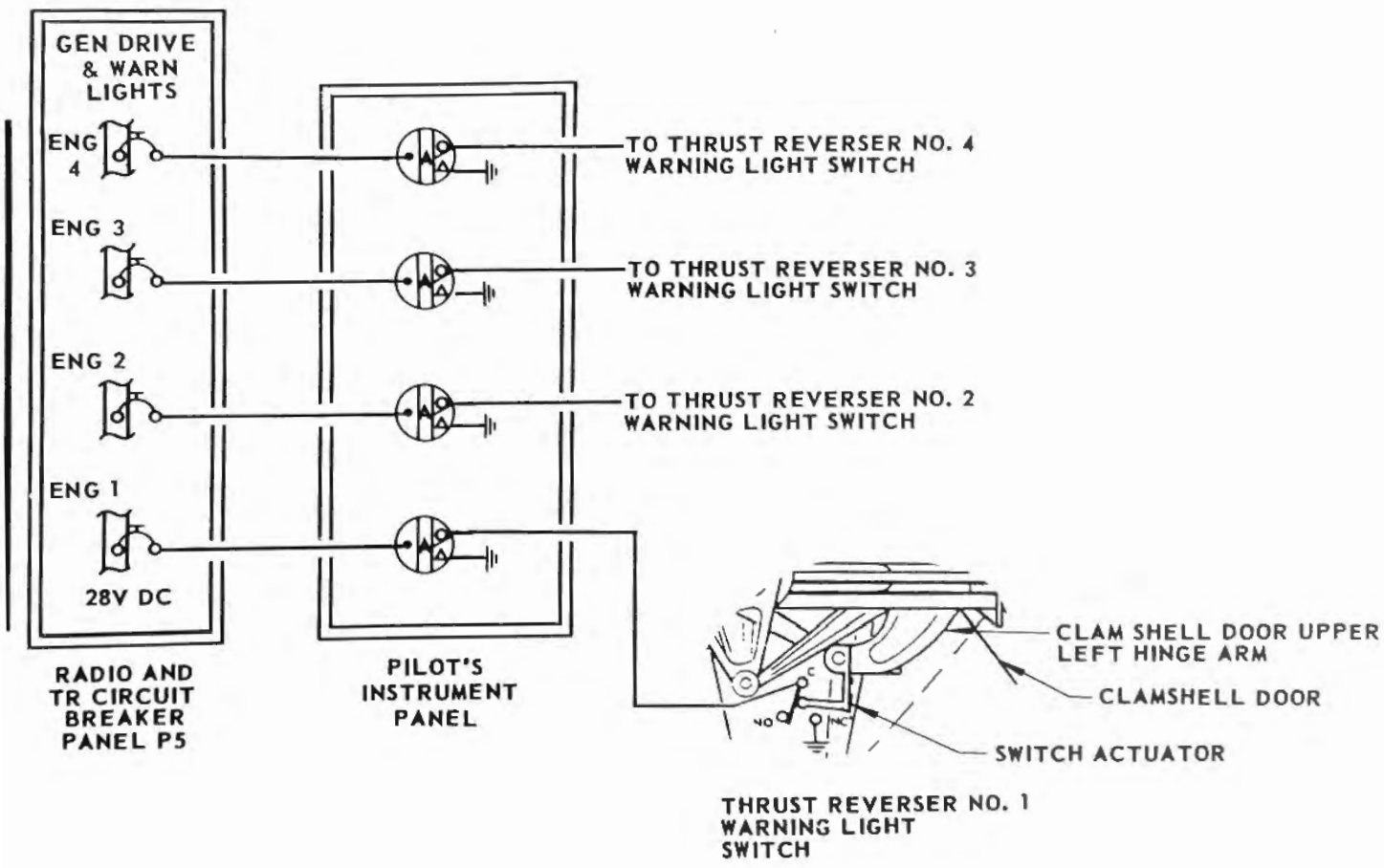
END

THRUST REVERSER POSITION INDICATING SYSTEM - DESCRIPTION AND OPERATION

1. General

A. A warning light for each thrust reverser provides an indication that the clamshell doors are operating. Illumination of the warning lights indicates only that the doors have departed from the extreme forward thrust position and does not positively verify that the doors have arrived at the extreme reverse thrust position. In the forward thrust position, the clamshell doors are open; in the reverse thrust position, the doors are closed.

B. The warning light system consists of a warning light switch and warning light for each engine and is powered by 28 volt power. Each warning light switch is mounted near the upper hinge arm of the left clamshell door. An actuator fastened to the end of the hinge arm holds the switch plunger in the off position during forward thrust operation. The warning lights are located on the engine instrument panel.



Thrust Reverser Position Indicating System Schematic
Figure 1

THRUST REVERSER POSITION INDICATING SYSTEM - TROUBLE SHOOTING

1. General

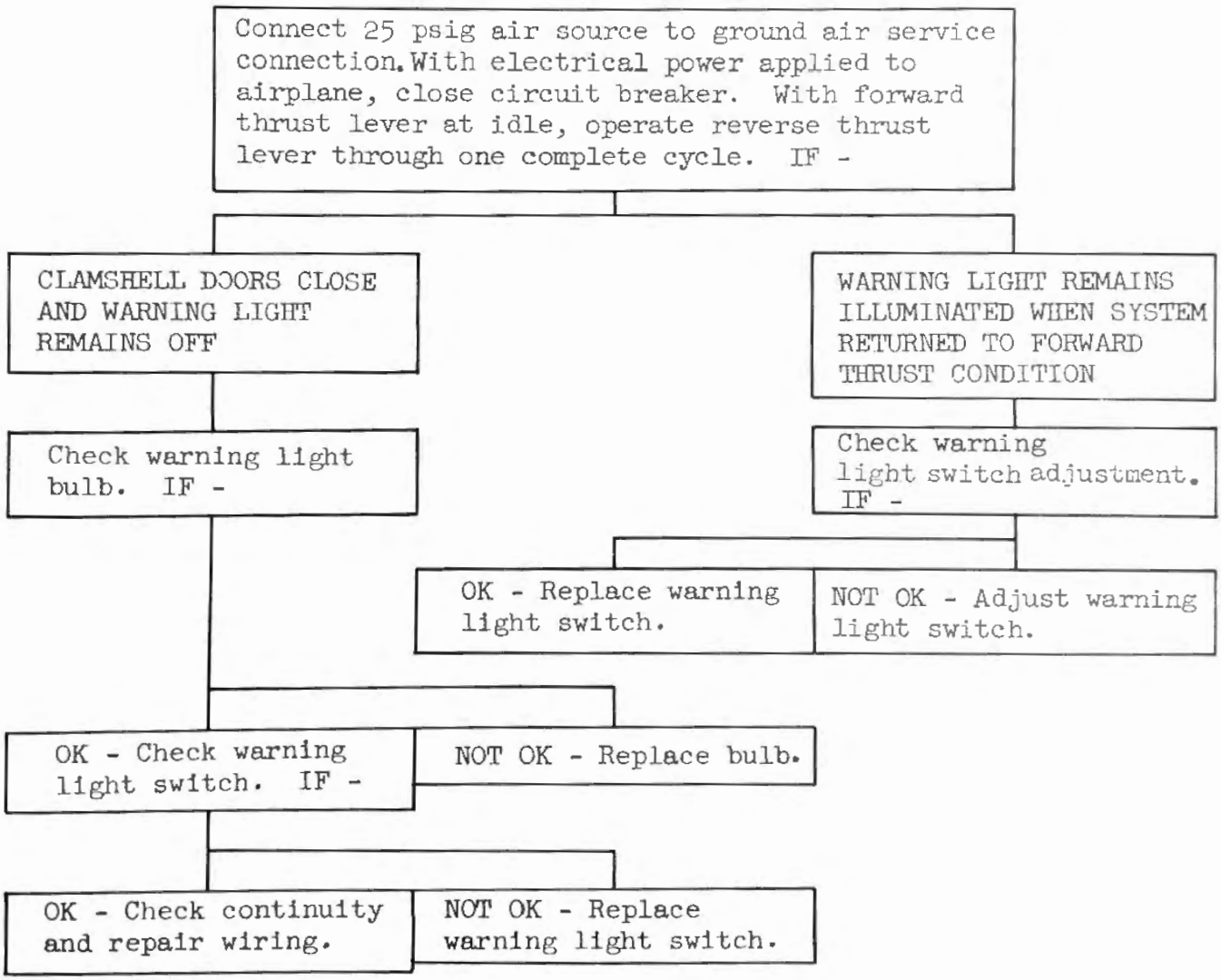
A. Trouble shooting of the thrust reverser position indicating system can be performed without operating the engines. An external air source capable of supplying a pressure of 25 psig is satisfactory for operating the system. Caution must be exercised when using an outside air source to avoid violent operating speeds.

B. In the forward thrust position, the clamshell doors are open; in the reverse thrust position, the doors are closed.

C. Equipment

(1) Air pressure source - 200 psig capacity. Use only clean, dry air.

2. Thrust Reverser Position Indicating System Trouble Chart



WARNING LIGHT SWITCH - MAINTENANCE PRACTICES

1. Adjustment/Test Warning Light Switch

A. General

(1) In the forward thrust position, the clamshell doors are open; in the reverse thrust position, the doors are closed.

B. Equipment

(1) Air pressure source capable of furnishing 200 psig.

C. Adjust Warning Light Switch

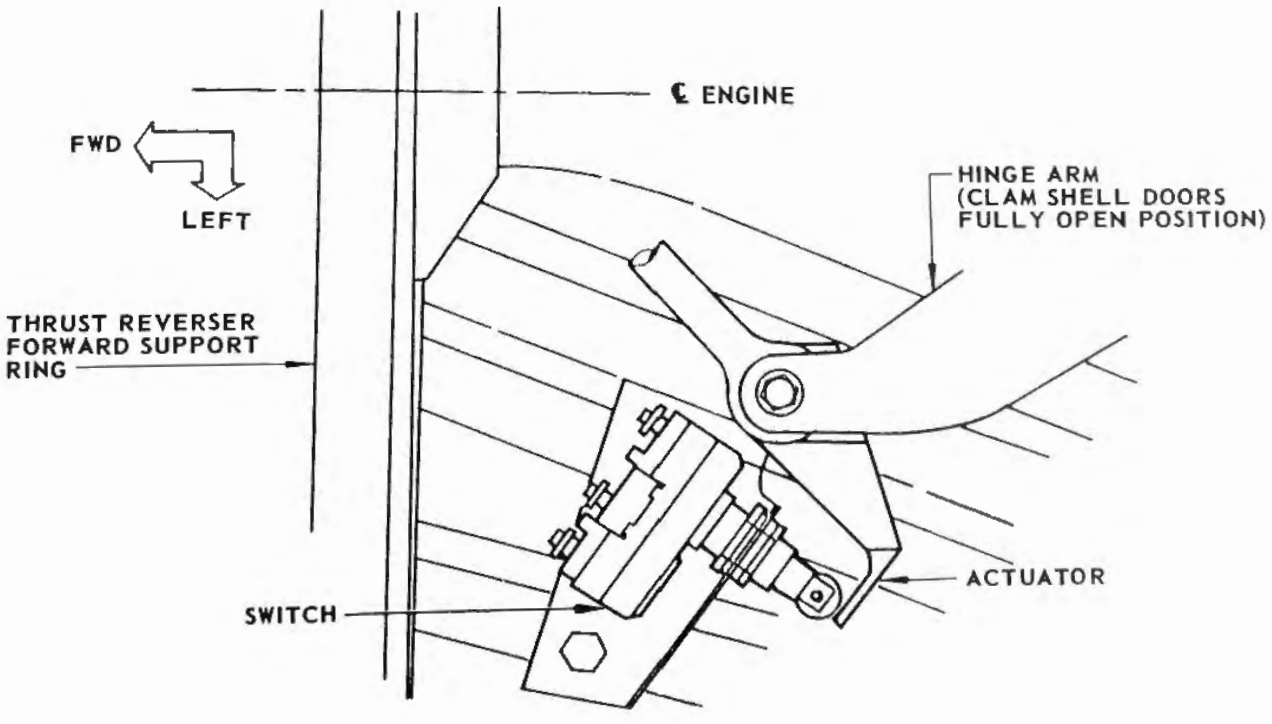
(1) Remove left engine cowl panel.

(2) Remove center vane assembly on left side of thrust reverser.

(3) Manually open clamshell doors to full forward thrust position.

CAUTION: DO NOT BOTTOM SWITCH. SWITCH DAMAGE CAN RESULT.

(4) If switch is being installed, adjust switch position so that plunger is depressed approximately 1/8 inch. (See figure 201.)



Warning Light Switch Installation
Figure 201

(5) Manually move left clamshell door aft 3/8 (+3/64 / -1/64) inch (toward reverse thrust position). Measure distance, along horizontal center line of thrust reverser, of forward end of door from forward support ring.

(6) Adjust switch position until circuit is just closed.

(7) Install center vane assembly.

(8) Install engine cowl panel.

D. Test Warning Light Switch

(1) Remove left engine cowl panel.

(2) Connect electrical power to warning light circuit.

(3) Place forward and reverse thrust levers at idle.

(4) Connect 25 psig air source to ground air service connection in order to hold door actuator pistons against internal stops. Check that all moisture is out of air hose before connecting to ground air service connection.

CAUTION: APPLY PRESSURE SLOWLY TO AVOID VIOLENT OPERATING SPEEDS.

NOTE: Volume capacity of air source is important. Therefore, minimum ground air line size should be equivalent to normal thrust reverser pressure line. The gage should be located close to the ground connection shuttle valve.

(5) Check that reverser warning light on engine instrument panel is not illuminated.

(6) Move reverse thrust lever to interlock position (60 degrees of lever movement and approximately 15 per cent power condition). Check that reverser warning light illuminates.

(7) Move lever to maximum reverse thrust position and return to interlock position. Check that light remains illuminated during entire cycle.

(8) Return lever to idle position. Check that reverser warning light is off.

(9) Disconnect air source and electrical power.

(10) Install engine cowl panel.

END

THRUST REVERSER - DESCRIPTION AND OPERATION

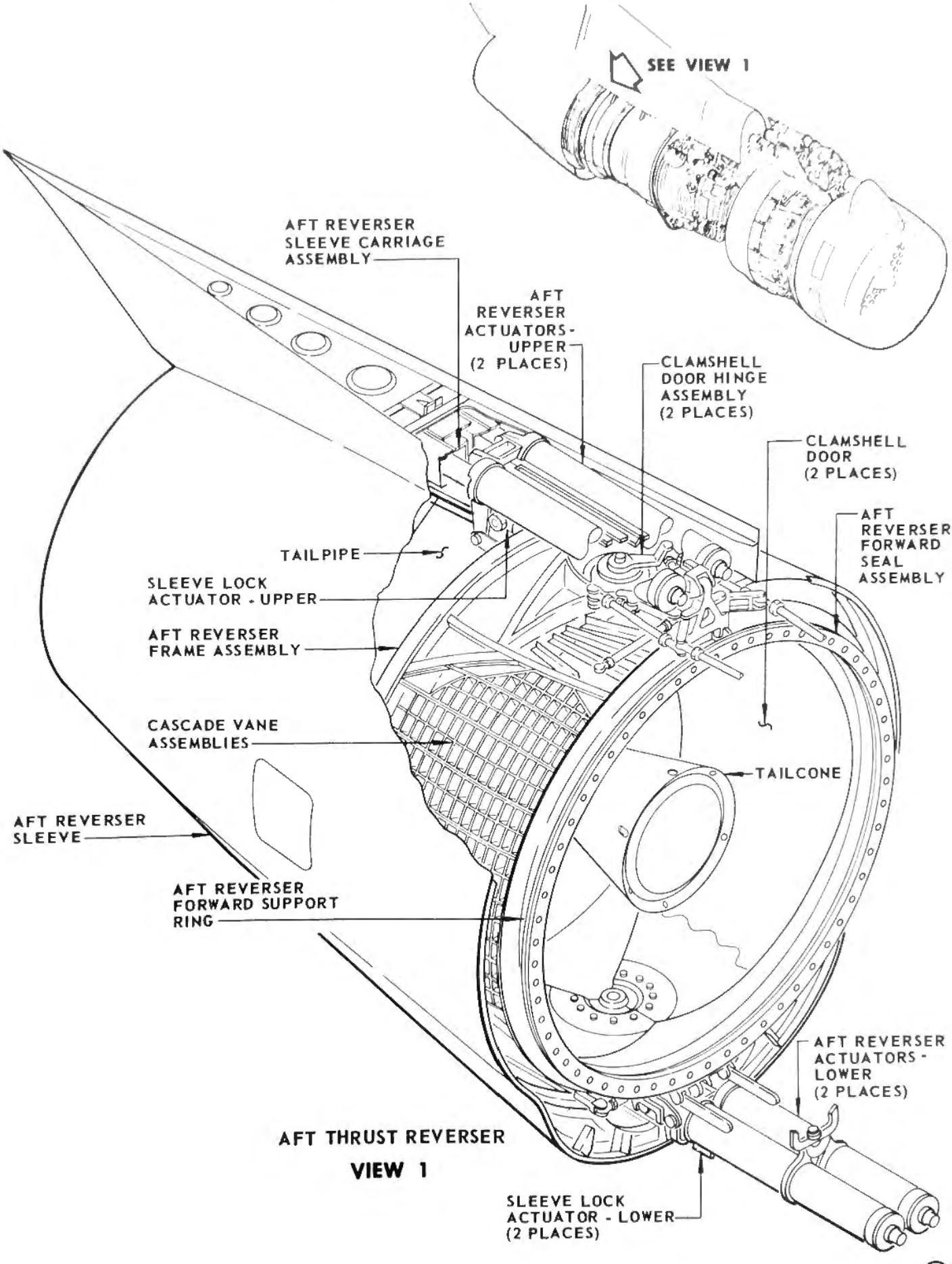
1. General

A. The thrust reverser on the JT3D turbofan engine (figure 1) is used to reduce the length of the landing roll and consists of an aft thrust and a forward thrust reverser. The thrust reverser on each engine operates independently. Flow reversing components on the forward thrust reverser are located circumferentially around the first stage compressor case. During forward thrust operation the exhaust air from the fan section of the first stage compressor is discharged in an aft direction from a duct created by the power plant diaphragm and the cowl ring assembly. The aft thrust reverser, during forward thrust operation, is an intermediate path for exhaust gas flow between the engine and the tailpipe. During reverse thrust operations the forward thrust reverser actuators move the cowl ring aft and reposition the blocker doors, lower vane assemblies, and baffle assemblies to discharge the fan exhaust air in a forward direction. The aft thrust reverser actuators move the aft thrust reverser sleeve aft uncovering the cascade vane assemblies. Movement of the sleeve causes the clamshell doors to close through the action of a hinge drive mechanism connecting the sleeve and the clamshell door hinge arm. The aft thrust reverser actuates simultaneously with the forward thrust reverser. Engine exhaust gases are diverted through the cascade vane assemblies.

2. Aft Thrust Reverser

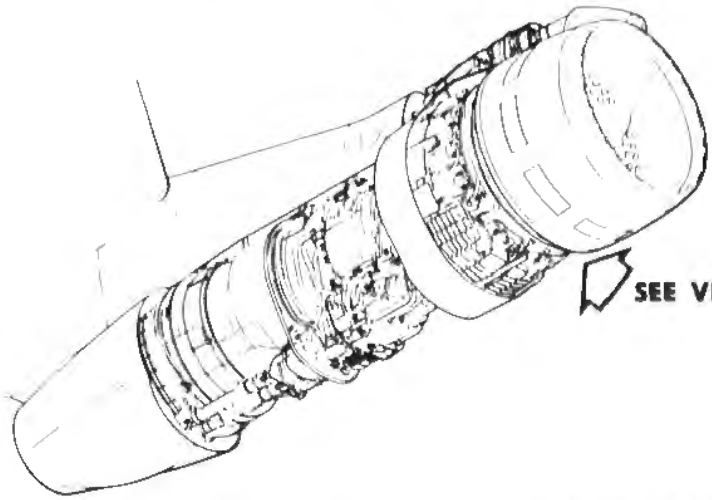
A. General

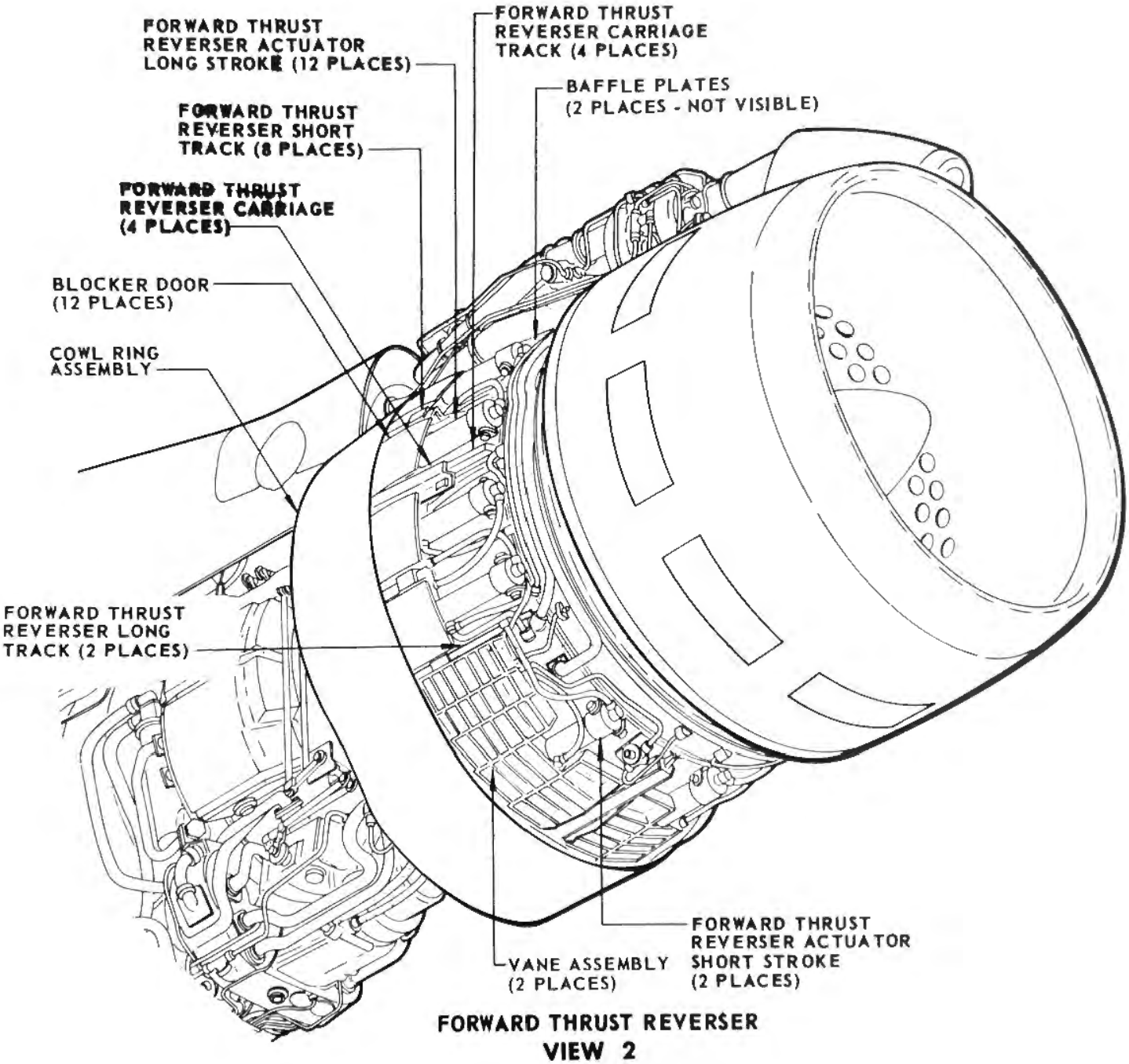
(1) The aft thrust reverser consists of the aft thrust reverser frame assembly, two clamshell doors, twenty cascade vane assemblies, two door hinge assemblies, the aft thrust reverser sleeve, and tracks and carriage assemblies. (See figure 1.) The tailpipe is mounted to the aft mounting ring of the frame assembly and lies within the sleeve. The thrust reverser installations for each engine are identical except for the cascade vane assemblies. The deflectors for various vane assemblies on each side of each engine are oriented at different angles in order to prevent exhaust gas ingestion by the adjacent engine. Seals are installed on the clamshell door aft edges, the door hinges, and the aft thrust reverser forward support ring to minimize exhaust gas leakage during forward thrust operation.



AFT THRUST REVERSER
VIEW 1

Fan Engine Thrust Reverser
Figure 1 (Sheet 1 of 2)





FORWARD THRUST REVERSER
VIEW 2

(2) The aft thrust reverser is pneumatically operated by bleed air from the high pressure compressor section. The thrust reverser control system directs pneumatic air to the sleeve lock actuators and reverser actuators. For reverse thrust operation, air is directed to the sleeve lock actuators and reverser actuators in sequence, releasing the sleeve and moving it aft, causing the clamshell doors to rotate aft and toward the engine centerline by the action of the hinge drive mechanism connecting the sleeve and the clamshell door hinge arms. For forward thrust operation, the reverser actuators move the sleeve and clamshell doors forward. The sleeve fairs with the engine cowling and covers the cascade vane assemblies.

B. Aft Thrust Reverser Frame Assembly

(1) The thrust reverser frame is a welded structure to which the clamshell doors, upper actuator assemblies, cascade vane assemblies and tailpipe are attached (See figure 1). It consists of an aft mounting ring, a forward mounting ring and connecting structure. The frame assembly is attached to the rear of the engine. The tailpipe is attached to the aft mounting ring of the frame assembly. The cascade vane assemblies are attached to the frame between the forward and aft rings. Hinge support assemblies at the upper and lower vertical centerlines provide for attachment of the clamshell door hinge assemblies.

C. Clamshell Doors

(1) The thrust reverser clamshell doors are located inside the aft thrust reverser frame assembly and are attached to the clamshell door hinge assemblies at the upper and lower vertical centerlines of the reverser frame. (See figure 1) The clamshell door assemblies are welded structures to which are attached hub seals and an aft seal. Holes are provided on the hub seal for mounting the doors on the hinge arms. The aft seal insures an even fit between the door and the frame assembly when the doors are in the open position.

D. Cascade Vane Assemblies

(1) Ten cascade vane assemblies are mounted on each side of the aft reverser frame assembly, except for the right side of engines No. 1 and 3 and the left side of engines No. 2 and 4 (See figure 1). There are eight cascade vane assemblies and two blocker assemblies on these sides. Each vane assembly is a casting with a row of built in turning vanes. The forward end of the vane assembly is attached to the forward end of the reverser frame. The aft end is inserted in the aft ring of the frame. There are several different cascade vane assemblies with turning vanes installed at different angles to achieve the desired direction of exhaust gas deflection during reverse thrust. The blocker assemblies are metal channels with end plates for attachment to the reverser frame. No exhaust gas flows through the blocker assemblies.

E. Clamshell Door Hinge Assemblies

(1) A clamshell door hinge assembly is installed through the top and bottom surfaces of the thrust reverser frame assembly. (See figure 1.) Each hinge assembly consists of an inner and outer shaft with flanges to which the clamshell door hinge drive mechanism and aft follow-up rods are attached. A roller bearing and a ball bearing are installed between the shafts, and a roller bearing is installed between the outer shaft and the frame. The inner shaft rotates within the outer shaft and the outer shaft within the frame assembly during clamshell door actuation.

F. Aft Thrust Reverser Sleeve

(1) The aft thrust reverser sleeve is a mechanically actuated one piece cowl and fairing that rides on roller truck mechanisms and tracks. (See figure 1.) The aft thrust reverser actuators move the sleeve aft for reverse thrust operation and forward for forward thrust operation. During forward thrust operation the sleeve encloses and covers all other thrust reverser components and the tailpipe, fairing with the engine cowl panels and the strut fairing. A roller assembly which rides in the track between the two upper actuators, and attachments for the upper actuator rod ends are at the top of the sleeve. A roller truck assembly at the bottom of the sleeve attaches to the lower actuator rod end. Four support links at the top and bottom and right and left hand sides of the sleeve attach the sleeve to roller trucks on the tailpipe. Attachments for the hinge drive mechanism rod assemblies are at the upper and lower forward edges of the sleeve.

G. Tailpipe

(1) The tailpipe consists of a cylindrical cone with support tracks for the aft sleeve roller trucks welded to the surface at the upper and lower vertical centerlines and the left and right horizontal centerlines. (See figure 1.) The tailpipe is bolted to the aft mounting ring of the reverser frame and lies entirely within the aft reverser sleeve during both forward and reverse thrust operations.

3. Forward Thrust Reverser

A. General

(1) The forward thrust reverser consists of twelve blocker doors, two vane assemblies, two baffle assemblies, a cowl ring assembly, tracks and carriage assemblies. (See figure 1.) The cowl ring assembly is a two piece structure joined at the top and bottom. Each section has a seal attached to the forward inner edge with screws.

(2) The forward thrust reverser is pneumatically operated by bleed air from the high pressure compressor section. The thrust reverser control system positions the blocker doors and cowl ring assembly for the forward or reverse thrust positions. For forward thrust operation the blocker doors lay flat around the compressor case, allowing the fan air to be discharged in an aft direction from a duct created by the power plant diaphragm and the cowl ring assembly. For reverse thrust operation, the forward thrust reverser actuators move the cowl ring, vane assemblies and baffle assemblies aft and rotate the blocker doors aft and inward to block the aft flow of the fan air. This action eliminates the fan air duct and causes fan air to be discharged in a forward direction.

B. Cowl Ring Assembly

(1) The cowl ring assembly is a two-piece assembly surrounding the engine immediately aft of the fan section of the first stage compressor. (See figure 1.) It forms the outer wall of the fan air duct during forward thrust operation. The right and left hand cowl ring assemblies are attached together by bolts through structure at the upper and lower vertical centerlines. Each assembly consists, basically, of an outer skin which fairs with the engine cowling, an inner skin which is curved to form a duct with the power plant diaphragm, web assemblies joining the inner and outer skin, and supporting ribs and structure. Attachment provisions for the blocker door links, baffle assemblies, and vane assemblies are on the web structure. Openings for the forward thrust reverser track assemblies are also located in the web structure. The cowl ring assembly rides on four carriage assemblies, located on the upper and lower vertical centerlines, and left and right horizontal centerlines. These carriage assemblies are attached to the web structure and ride on tracks mounted forward of the cowl ring assembly. A gas seal is attached to a seal angle at the junction of the inner skin and the web structure.

C. Blocker Doors

(1) Twelve blocker doors, six on each side of the engine, deflect fan air exhaust in a forward direction during reverse thrust operation. Each door is a rectangular, curved casting of magnesium alloy. (See figure 1.) Attachment provisions on the door allow it to be connected to the door links and the forward thrust reverser actuator rod ends. Ball bearing rollers installed on each side of the blocker door ride in the engine mounted thrust reverser tracks providing the translation and rotation capability of the blocker doors. Teflon slides are used instead of rollers on later installations.

D. Vane Assemblies

(1) In the lower fan exhaust area two turning vane assemblies are installed to direct the fan exhaust air flow forward during reverse thrust operation. They are located on either side of the lower sleeve carriage (6:00 o'clock position) and are bolted to the carriage. Ball bearing rollers, or slide blocks on later airplanes, mounted on the upper side of the vane assembly ride in the grooves of engine mounted guide tracks to provide for translation of the vane assemblies. A fixed vane installation is possible due to the accessory section bulge at the lower area of the engine nacelle. This permits sealing of this portion in reverse since the clearance between the power plant diaphragm and the cowl ring assembly is nominally 0.02 inch in this area. Vanes are installed in such a manner as to provide the optimum fan exhaust gas direction for reverse thrust and to minimize self ingestion or cross ingestion.

E. Baffle Assemblies

(1) Two baffle plate assemblies, one on each side of the upper sleeve carriage assembly (12:00 o'clock position) prevent fan air exhaust from impinging on the strut seal panel area during reverse thrust operation. (See figure 1.) On the upper side the baffle plates are bolted directly to the sleeve carriage. Ball bearing rollers, or slide blocks on later airplanes, on the lower side of the baffles ride in the grooves of engine mounted guide tracks to provide for translation of the baffles. The baffle plate is a solid one-piece casting with a flat undersurface in the area of gas impingement.

F. Tracks and Carriage Assemblies

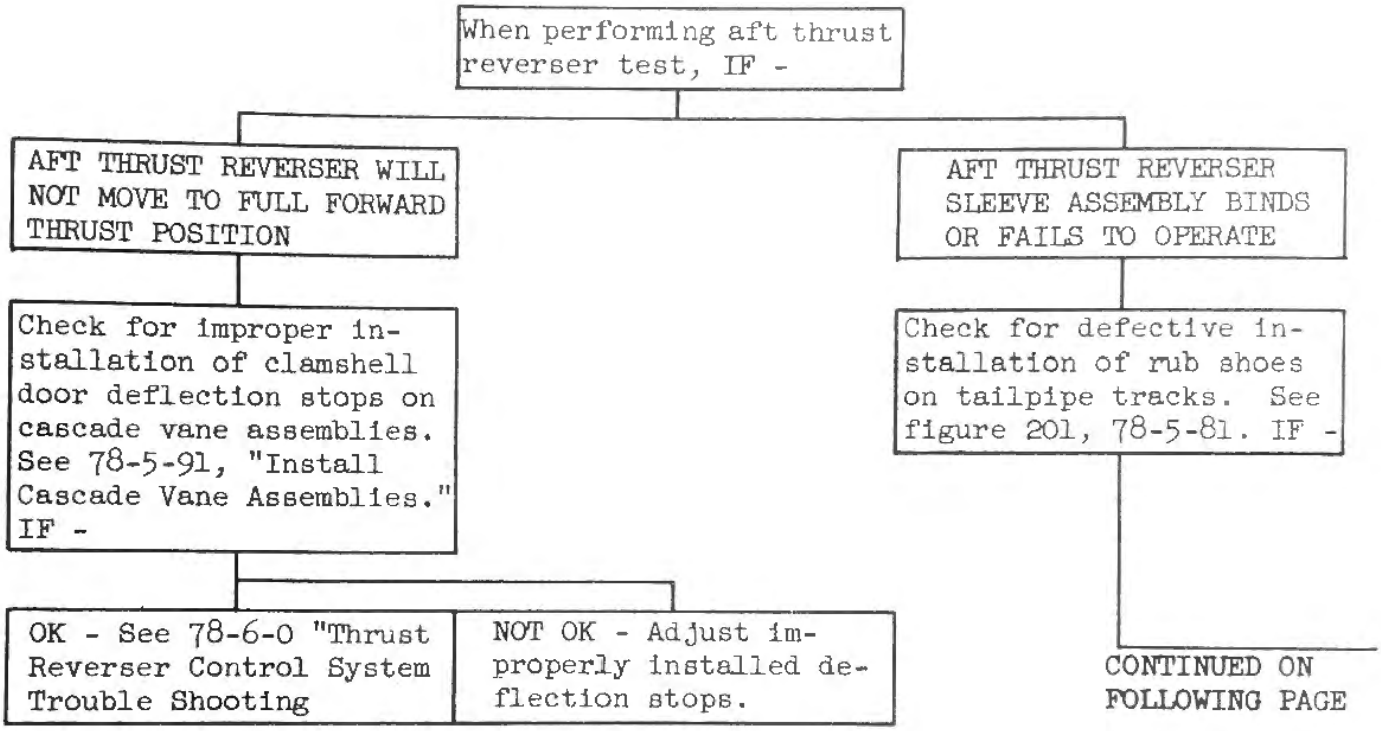
(1) Engine mounted guide tracks, twelve short tracks and four long tracks, provide grooves for the ball bearing rollers or slide blocks on the flow reversing components and carriages of the forward thrust reverser to ride in during thrust reverser translation. The tracks are mounted around the circumference of the fan section of the forward compressor case just forward of the cowl ring assembly. The long tracks are located at the 3:00, 6:00, 9:00, and 12:00 o'clock positions and are the guide tracks for the four sleeve carriage assemblies. The sleeve carriage assemblies are mounted over the tracks and have four internally mounted rollers which ride on the guide tracks. The carriages are bolted directly to the forward web of the cowl ring assembly and provide the main support for the cowl ring. The carriages at the 3:00 and 9:00 o'clock positions have slotted holes on either side to allow the roller on one side of each of the blocker doors at this location to ride in the respective long track groove. The other blocker doors and the other side of the blocker doors adjacent to the side carriages ride in the short tracks. One side of each of the baffle assemblies and each of the turning vane assemblies ride in short track grooves.

THRUST REVERSER - TROUBLE SHOOTING

1. General

   A. If the cause of the trouble is not isolated using the trouble chart, the trouble probably lies in the thrust reverser control system. Perform trouble-shooting of the control system per 78-6-0, "Thrust Reverser Control System Trouble Shooting."

2. Aft Thrust Reverser Trouble Chart



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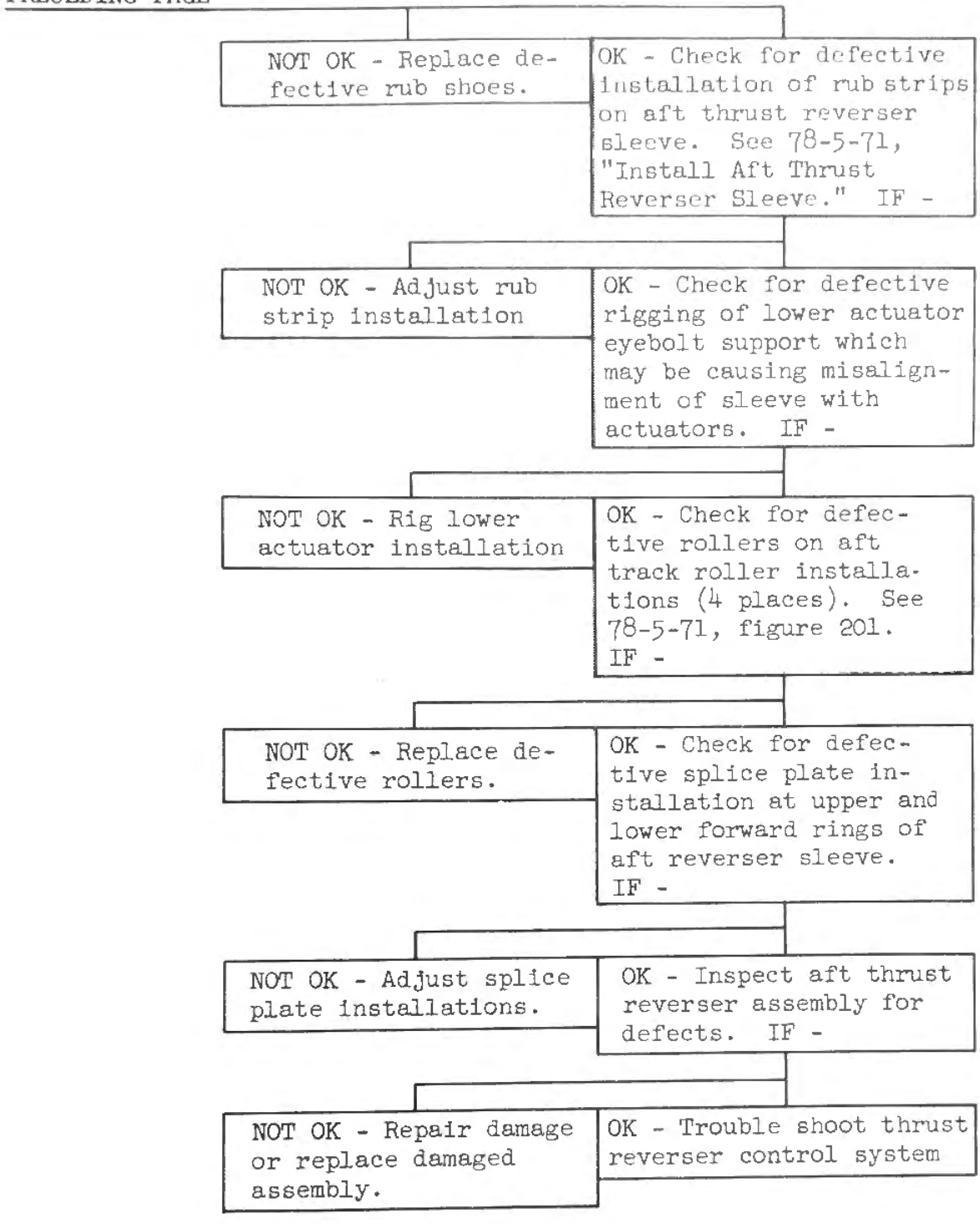
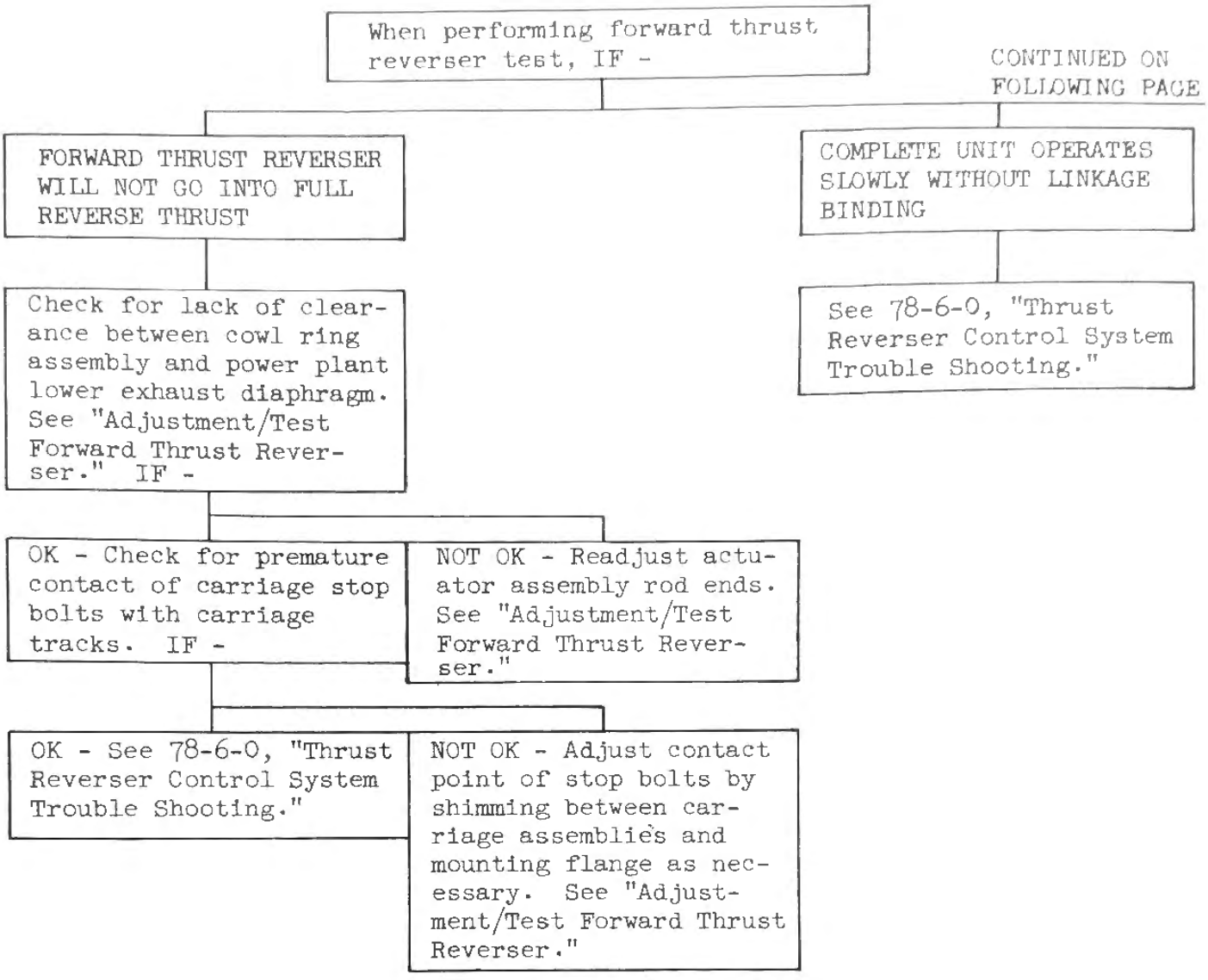


2. Forward Thrust Reverser Trouble Chart



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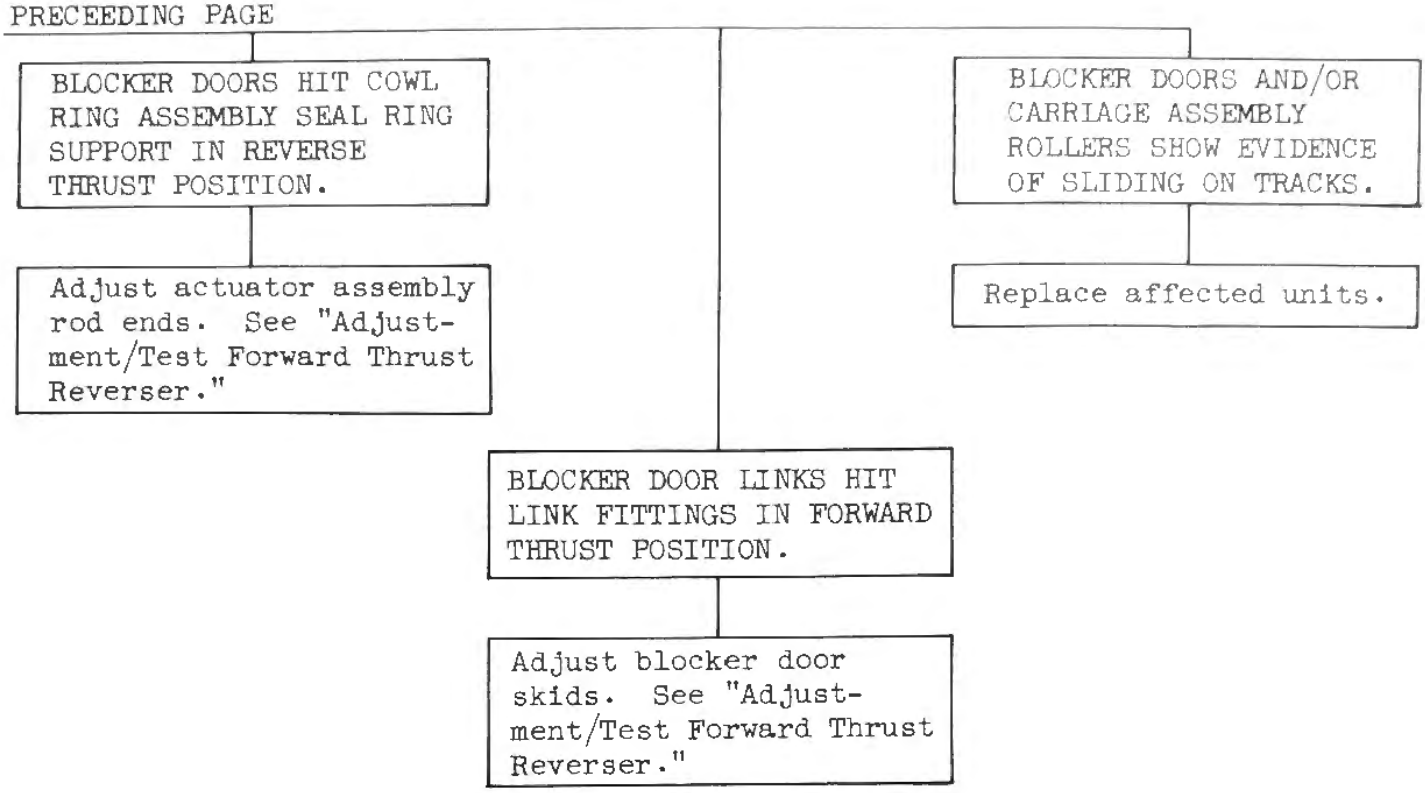


FORWARD THRUST REVERSER - MAINTENANCE PRACTICES

1. Removal/Installation Forward Thrust Reverser

A. General

(1) The forward thrust reverser components are located around the circumference of the first stage compressor case of the engine and cannot, therefore, be removed from the engine as a unit. Removal and installation of the forward thrust reverser components, consisting of the cowl ring assembly, blocker doors, vane assemblies, tracks and carriage assemblies are covered in the respective components maintenance practices. See Sections 78-5-11 through 78-5-51.

2. Adjustment/Test Forward Thrust Reverser

A. Equipment and Materials

(1) Air pressure source - 0 to 60 psig, using dry air

B. Rig Forward Thrust Reverser Installation

(1) Adjust alignment of carriage assemblies and cowl ring.

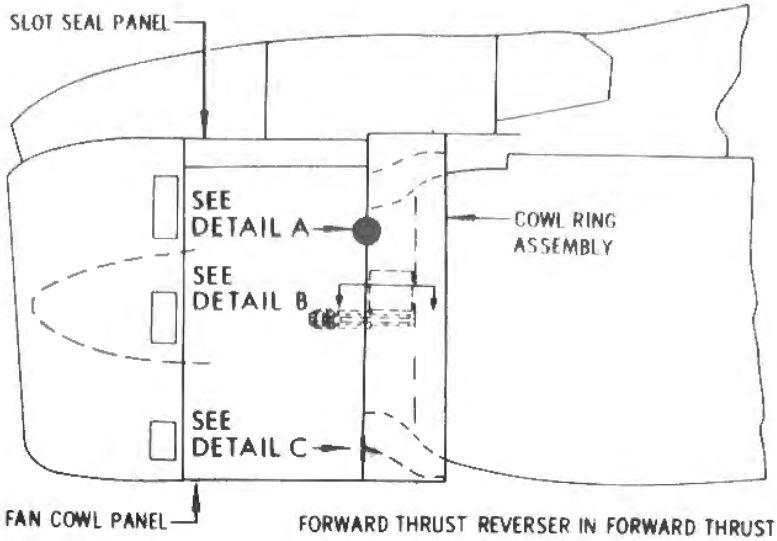
(a) On airplanes VH-EBA thru VH-EBK manually move cowl ring aft 7.50 (+0.00/-0.06) inches from forward thrust position. On airplanes VH-EBL and on, manually move cowl ring aft 7.50 (+0.00/-0.15) inches from forward thrust position. Add laminated shims as necessary between carriage flanges (4 places) and cowl ring so that carriage stop bolts on all four carriages engage simultaneously with bosses on carriage tracks. (See view 1, figure 201.)

NOTE: If tapered shim is required, fabricate as follows:

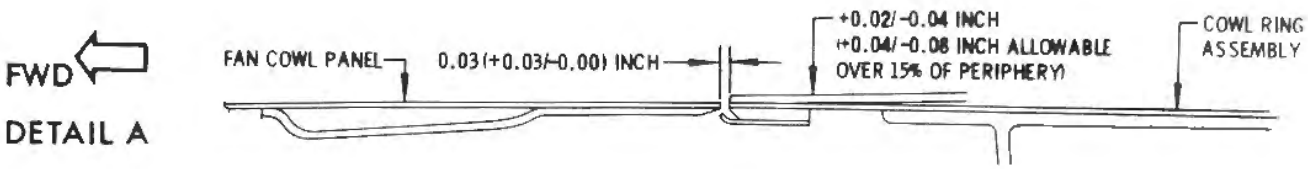
Material - 2024-T3 sheet per QQ-A-355
Thickness - 0.063 inch maximum
Length and Width - same as laminated shims used.
Taper - 0.010 inch per inch maximum
Finish - Skydrol Resistant Finish 2.30.

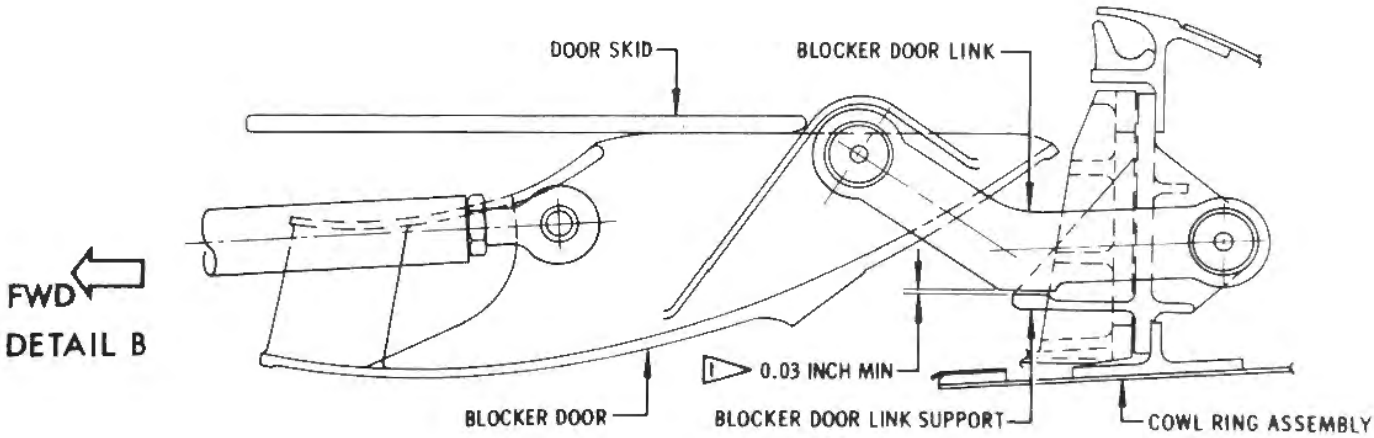
(b) With cowl ring restrained in full reverse position per step (a) above, the clearance between the diaphragm and the sleeve at the dimple in the lower section of sleeve should be 0.02 inch minimum at the closest point. (See Detail D.) When installing cowl ring on airplanes VH-EBL and on, required gap can be obtained by shimming fan air exhaust diaphragm as described below:

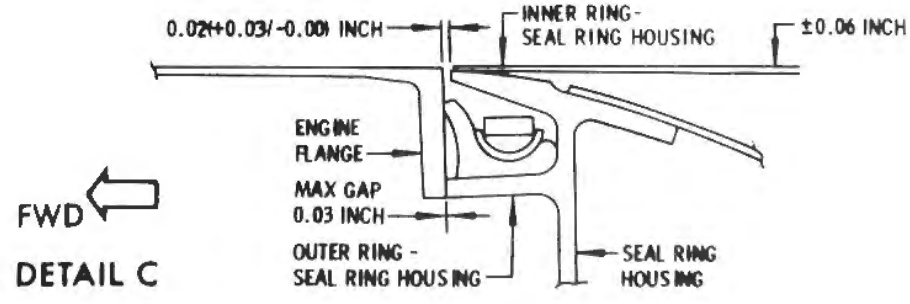
1) Remove antirotation clips (two places) from exhaust diaphragm and from engine flange. (See view A-A.)



FORWARD THRUST REVERSER IN FORWARD THRUST POSITION

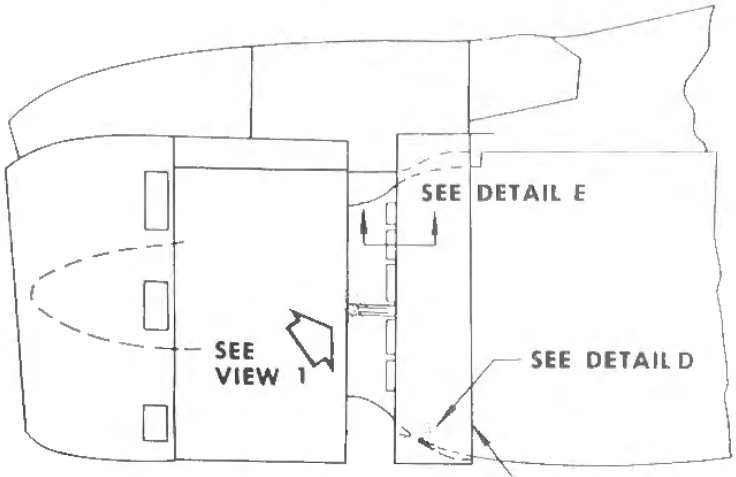




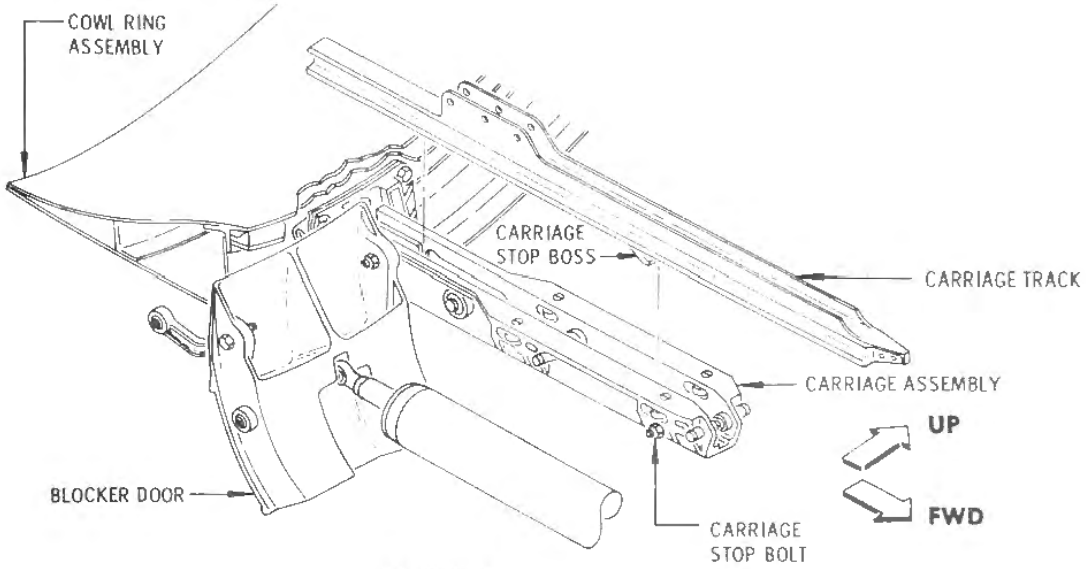


1 FILE BOSS ON BLOCKER DOOR LINK IF REQUIRED FOR ADEQUATE CLEARANCE ON INSTALLATION. BRUSH ALODINE 1200 CH REWORKED AREAS

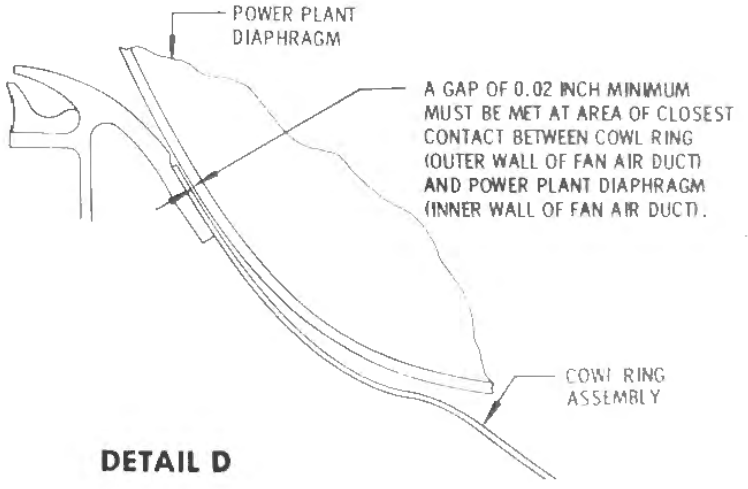
Forward Thrust Reverser Rigging
Figure 201 (Sheet 1 of 4)



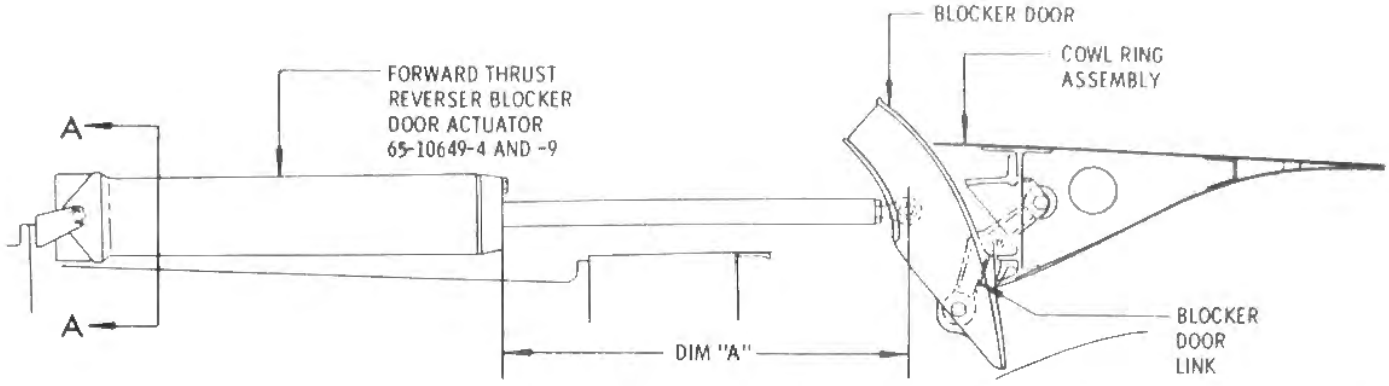
FORWARD THRUST REVERSER IN REVERSE THRUST POSITION



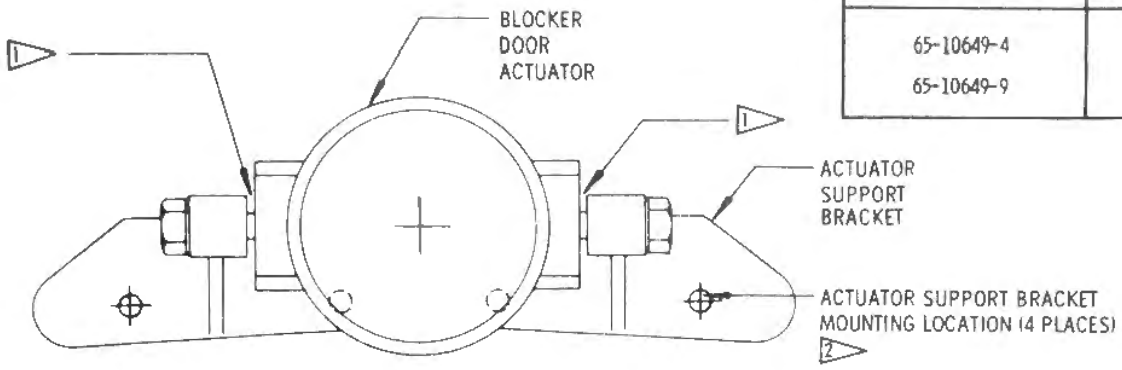
VIEW 1



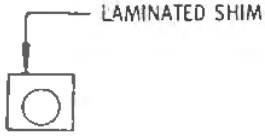
DETAIL D



ACTUATOR	DIM "A"
65-10649-4	11.65
65-10649-9	11.43



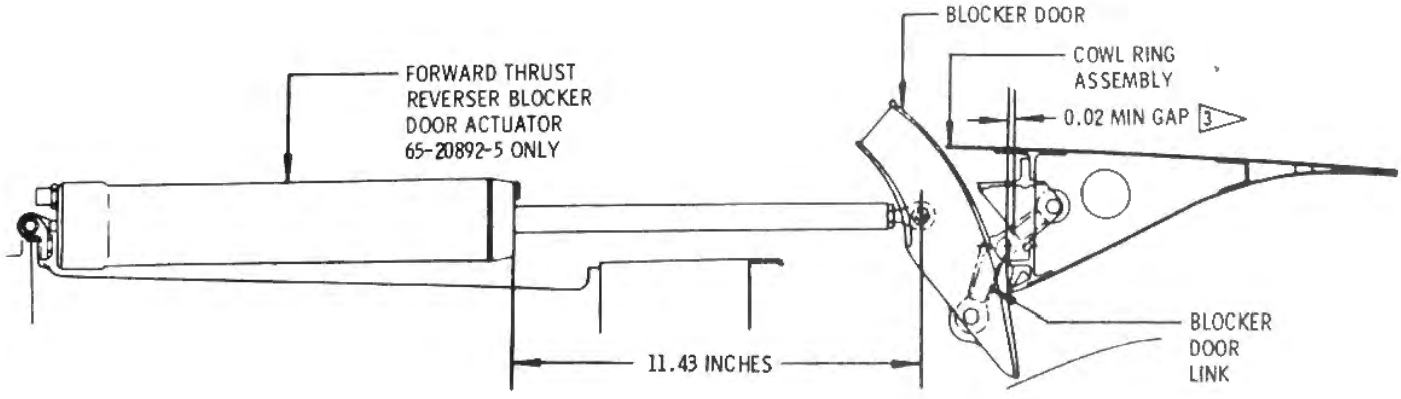
A-A



1 ADD WASHERS HERE AS REQUIRED

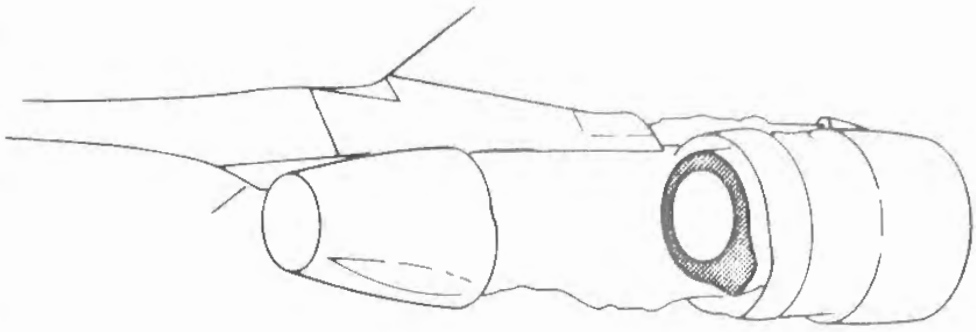
2 ADD LAMINATED SHIMS AS REQUIRED

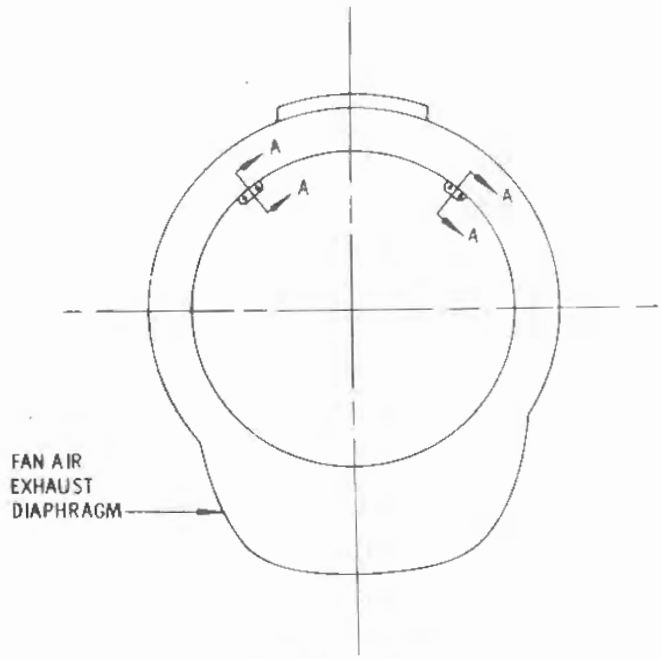
DETAIL E



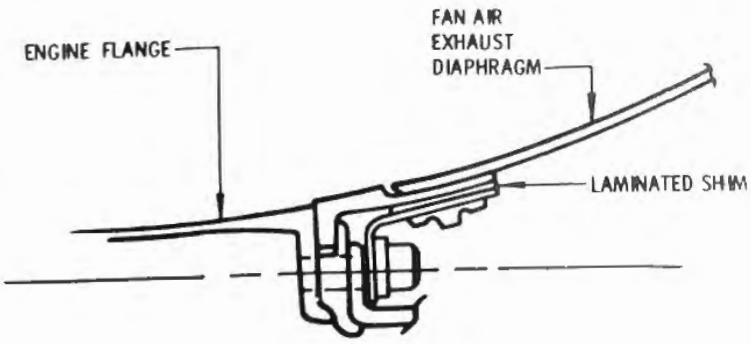
DETAIL F

3 VH-EBL AND ON. THIS GAP SHOULD BE ATTAINED WHEN RIGGING COWL RING DURING INSTALLATION.





REAR VIEW



A-A

EFFECTIVITY
VH-EBL AND ON

2) Add laminated shim between clip and exhaust diaphragm (two places) and remove laminations as necessary to obtain required gap.

3) Be sure that clips are firmly secured at engine flange and diaphragm ring attachment when shimming is completed.

(c) Adjust cowl ring and carriage assemblies so that cowl ring moves aft freely by hand from forward thrust position to full reverse thrust position.

(2) Adjust blocker door installation.

(a) With forward thrust reverser in forward thrust position, adjust each blocker door installation by positioning door inward against door skid and adjusting door skid to obtain 0.03 inch minimum gap between blocker door link and link support. (See Detail B.)

NOTE: Fan cowl panel and slot seal panel must be removed while making this adjustment.

(b) On airplanes VH-EBL and on, minimum gap of 0.02 inch should be maintained between blocker door flange and face of outer ring of seal ring housing with forward reverser and blocker doors in reverse thrust position. If necessary, gap may be obtained by adjusting length of actuator rod end.

(3) Adjust blocker door actuators alignment. (Applicable to actuators 65-10649-4 and -9.)

(a) Manually position cowl ring and blocker door into reverse thrust position.

(b) Remove bolt attaching actuator rod end bearing to actuator clevis attachment.

(c) Extend piston rod into reverse thrust position.

NOTE: The forward thrust reverser actuators are preset for extended length prior to installation on the airplane. The dimension from the rod end bearing centerline to the aft face of the bushing retainer plate with the actuator in the extended (reverse thrust) position is shown in detail E.

(d) Add washers at pivot end of actuator as required to reduce clearance between support bracket and actuator bearing to 0.016 inch maximum, and to align actuator rod end bearing with clevis of blocker door. (See detail E, figure 201.)

(e) To check alignment, hold actuator at pivot end and hold blocker door in maximum reverse thrust position. The rod end bearing must align with clevis of blocker door within 0.01 inch while in its free position.

(f) When misalignment exists, use laminated shims between actuator support brackets and engine flange as required. Use a maximum of 3 shims per bracket. A step of 0.010 inch is allowed between adjacent shims.

(g) After proper alignment is achieved in reverse thrust position, check alignment in forward thrust position by moving cowl ring and blocker door to within 3-1/2 inches from forward thrust position and checking that blocker doors can be raised or lowered within the lateral play of its rollers to the support tracks to allow the rod end to be inserted in the clevis attachment on the door.

(h) If misalignment exists in cruise position, rearrange washers located at actuator pivot point and shims between support bracket and engine flange.

(i) Check alignment again in forward thrust and reverse thrust positions.

(4) Actuator 65-20892-5 used on some installations can be preset for its extended length prior to installation. See detail F, figure 201. The extended length dimension is measured from the rod end bearing centerline to the aft face of the bushing retainer plate.

(5) Adjust rod ends on both vane assembly actuators so that actuators do not bottom in either forward or reverser thrust positions.

C. Test Forward Thrust Reverser Installation

(1) Place forward thrust reverser in reverse thrust position manually by sliding cowl ring aft until it stops. Check that cowl ring has moved aft to full reverse thrust position without binding.

(2) Check that carriage stop bolts (4 places) engage with stop bosses on carriage tracks. (See view 1, figure 201.)

(3) Check that minimum gap of 0.02 inch exists at point of closest contact between inner cowl ring duct skin and diaphragm at lower vertical centerline as shown in detail D.

(4) Place forward thrust reverser in forward thrust position manually by sliding cowl ring forward till it stops.

(5) Check cowl ring - engine flange alignment. (See detail C.)

(a) Make this check with ground air source connected at ground service connection and regulated to 25 psig. See 78-6-0 for instructions on connection of ground air source.

(b) Check that inner ring of seal ring housing of cowl ring meets inner diameter of engine flange within ± 0.06 inch maximum.

(c) Check that gap of 0.02 (+0.03/-0.00) inch exists between face of inner ring of seal ring housing and face of engine flange.

(d) Check for maximum gap of 0.030 inch between face of engine flange and face of outer ring of seal ring housing.

(6) Check alignment of cowl ring and fan cowl panel, shown in detail A.

(7) Check blocker door alignment.

(a) Check that each blocker door moves freely by hand on the links and tracks.

(b) Check that blocker door actuator rod end bearings mate with blocker door attachment bosses with no preload with forward thrust reverser manually positioned aft to reverse thrust position.

(c) With thrust reverser in forward thrust position, check that a gap of 0.03 inch minimum exists between link and link support fitting. (See detail B.) File the blocker door link boss as necessary to obtain this clearance.

(8) Check that vane assembly actuators do not bottom in either reverse or forward thrust positions.

3. Inspection/Check Fan Reverser

A. General

(1) Inspection of the fan reverser consists mainly of the following: checking the cowl ring assembly for missing or loose rivets, skin cracks, and freedom of travel, checking door linkage for freedom of travel, and actuators for damaged piston rods.

B. Check Cowl Ring (Forward Translating Sleeve)

(1) Check for missing or loose rivets. A maximum of two rivets in adjoining holes is permissible or 4 rivets in 15 inches in any one row is permissible before repair is required. For repair procedures, see Structural Repair Manual.

(2) Check for skin cracks. Cracks up to 4 inches are tolerable providing the crack does not go through more than 2 fastener holes. For repair procedures, see Structural Repair Manual.

(3) Check for freedom of travel. Cycle sleeve and check roller travel of carriages. Check for rubbing at top baffle plates and bottoming on chimney fairing of strut.

(4) Check follow-up installation.

(a) Check rods for distortion.

(b) Check rod end bearings for freedom and wear.

(5) Check blocker doors.

(a) With (cowl ring assembly) forward thrust reverser translating sleeve in reverse position, all doors shall operate freely without sticking or binding throughout full travel.

(6) Check actuators.

(a) Check alignment of actuator to blocker doors by disconnecting door and guiding piston rod to its recess.

(b) While actuator is disconnected, check movement of piston. Check rod for evidence of galling. Loss of plating on rod will cause rust.

(c) Check pneumatic flexible hoses to see if they are causing side loads or down loads on actuators and thereby restraining movement.

(d) With sleeve at full reverse travel with carriage stop bolts in contact with track lug, check to see if the 12 long actuators are bottomed without blocker doors contacting outer lip of sleeve.

COWL RING ASSEMBLY - MAINTENANCE PRACTICES

1. Removal/Installation Cowl Ring Assembly

A. General

(1) The cowl ring assembly is a two-piece assembly and may be removed from the engine by disconnecting the blocker doors, vane assemblies, and baffle assemblies from the cowl ring and then removing the bolts and screws holding the two halves of the ring assembly together at the upper and lower vertical centerline of the cowl ring.

(2) Individual cowl ring assembly halves are not interchangeable with units of other serial numbers. The sleeve assemblies are fabricated in matched sets to match the fan exhaust area and are serialized as a set.

B. Remove Cowl Ring Assembly

(1) Disconnect blocker doors from cowl ring assembly (see view 4, figure 201).

(a) Disconnect actuator from blocker door by removing actuator rod-to-blocker door attachment bolt.

(b) Remove bolt, nut, washer and cotter pin (2 places) at blocker door connections to cowl ring links (2 places each door on 12 blocker doors).

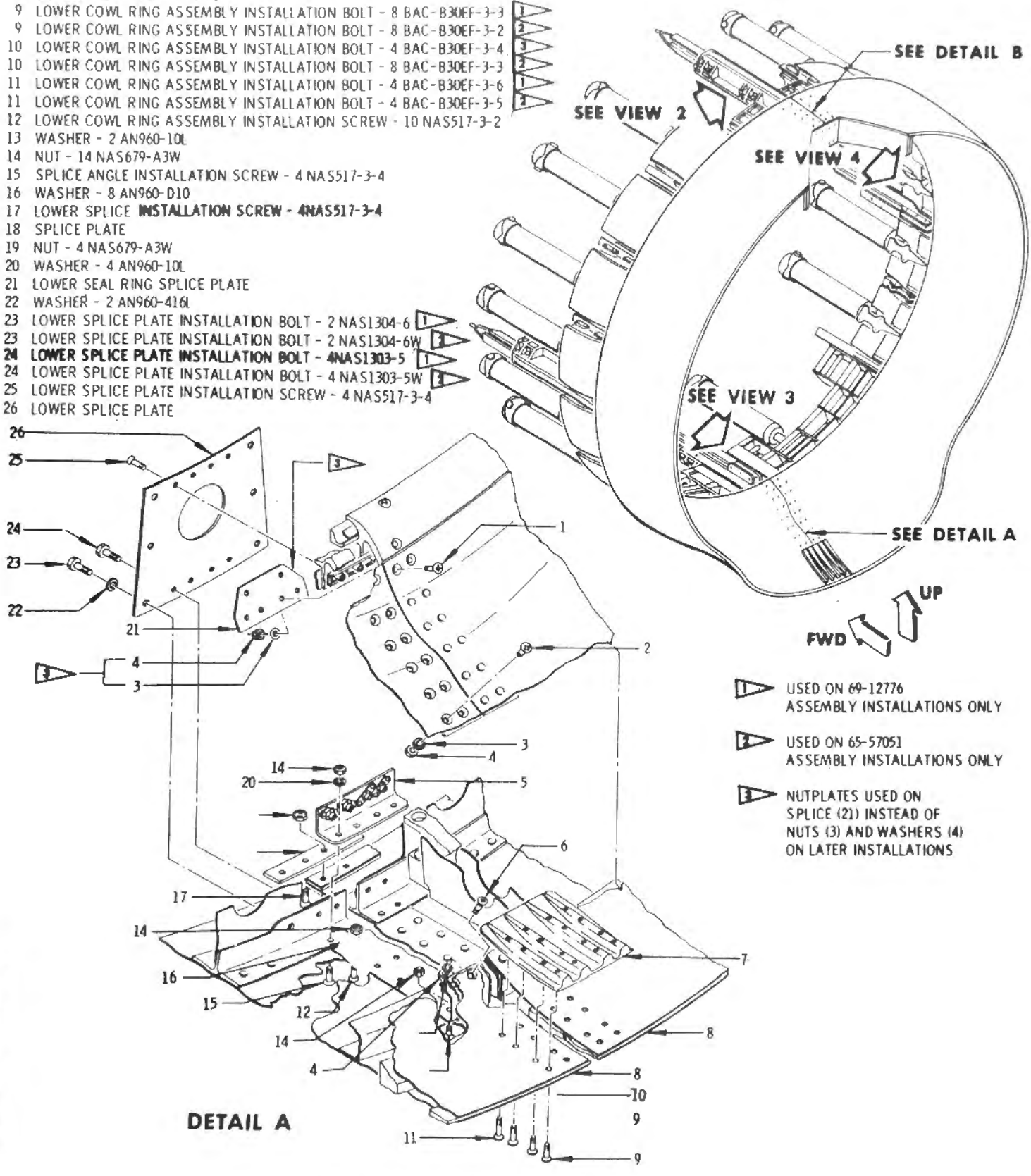
(2) Disconnect 4 carriage assemblies, located at upper and lower vertical centerlines, and left and right horizontal centerlines.

(a) Remove 4 bolts attaching carriage assemblies at upper and lower vertical centerlines to cowl ring. (See views 2 and 3.)

NOTE: Cowl ring assembly upper splice plate (36, detail B) is held to cowl ring assembly by carriage assembly on upper vertical centerline.

(b) Remove 5 bolts attaching carriage assemblies at left and right horizontal centerlines. (See view 4.)

1 LOWER SEAL RING SPLICE INSTALLATION SCREW - 6 NAS517-3-4
2 LOWER COWL RING ASSEMBLY INSTALLATION SCREW - 10 NAS517-3-2
3 WASHER - 16 AN960D10
4 NUT - 18 NAS679-A3W
5 LOWER SPLICE ANGLE
6 LOWER COWL RING ASSEMBLY INSTALLATION SCREW - 2 NAS517-3-3
7 LOWER AFT SPLICE PLATE
8 COWL RING ASSEMBLY HALF
9 LOWER COWL RING ASSEMBLY INSTALLATION BOLT - 8 BAC-B30EF-3-3 [1]
9 LOWER COWL RING ASSEMBLY INSTALLATION BOLT - 8 BAC-B30EF-3-2 [2]
10 LOWER COWL RING ASSEMBLY INSTALLATION BOLT - 4 BAC-B30EF-3-4 [3]
10 LOWER COWL RING ASSEMBLY INSTALLATION BOLT - 8 BAC-B30EF-3-3 [2]
11 LOWER COWL RING ASSEMBLY INSTALLATION BOLT - 4 BAC-B30EF-3-6 [1]
11 LOWER COWL RING ASSEMBLY INSTALLATION BOLT - 4 BAC-B30EF-3-5 [2]
12 LOWER COWL RING ASSEMBLY INSTALLATION SCREW - 10 NAS517-3-2
13 WASHER - 2 AN960-10L
14 NUT - 14 NAS679-A3W
15 SPLICE ANGLE INSTALLATION SCREW - 4 NAS517-3-4
16 WASHER - 8 AN960-D10
17 LOWER SPLICE INSTALLATION SCREW - 4NAS517-3-4
18 SPLICE PLATE
19 NUT - 4 NAS679-A3W
87 20 WASHER - 4 AN960-10L
21 LOWER SEAL RING SPLICE PLATE
22 WASHER - 2 AN960-416L
23 LOWER SPLICE PLATE INSTALLATION BOLT - 2 NAS1304-6 [1]
23 LOWER SPLICE PLATE INSTALLATION BOLT - 2 NAS1304-6W [2]
24 LOWER SPLICE PLATE INSTALLATION BOLT - 4NAS1303-5 [1]
24 LOWER SPLICE PLATE INSTALLATION BOLT - 4 NAS1303-5W [2]
25 LOWER SPLICE PLATE INSTALLATION SCREW - 4 NAS517-3-4
26 LOWER SPLICE PLATE



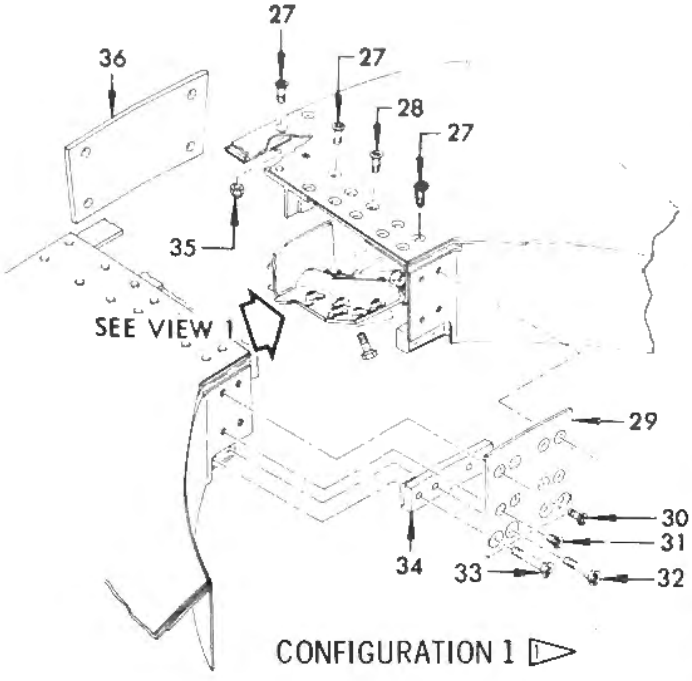
[1] USED ON 69-12776 ASSEMBLY INSTALLATIONS ONLY

[2] USED ON 65-57051 ASSEMBLY INSTALLATIONS ONLY

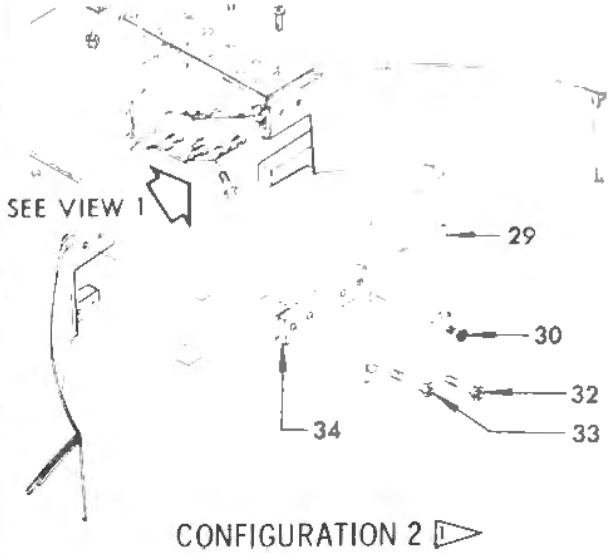
[3] NUTPLATES USED ON SPLICE (21) INSTEAD OF NUTS (3) AND WASHERS (4) ON LATER INSTALLATIONS

Cowl Ring Assembly Installation
Figure 201 (Sheet 1 of 4)

27 UPPER SPLICE CONNECTION SCREWS - 6 NAS517-3-4
28 UPPER SPLICE CONNECTION SCREWS - 6 NAS517-3-3
29 UPPER SPLICE PLATE
30 UPPER SPLICE PLATE INSTALLATION SCREWS - 4 NAS517-3-6
31 UPPER SPLICE PLATE INSTALLATION SCREWS - 4 NAS517-3-2
32 UPPER SPLICE PLATE INSTALLATION SCREWS - 2 NAS517-4-13
33 UPPER SPLICE PLATE INSTALLATION SCREWS - 2 NAS517-4-16
34 UPPER SPLICE ANGLE
35 NUT - 2 NAS679-A3W
36 COWL RING UPPER SPLICE PLATE (REMOVE WITH CARRIAGE ASSEMBLY)

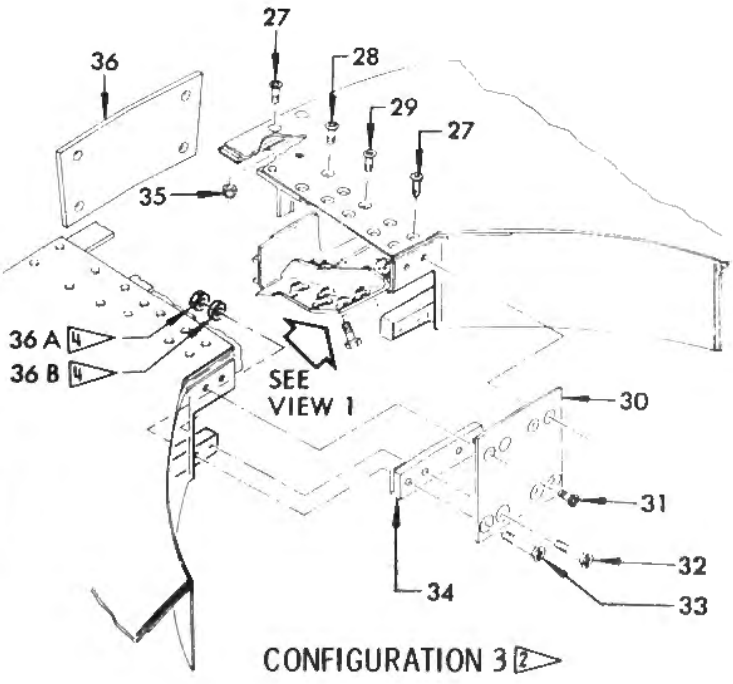


CONFIGURATION 1 [1]



CONFIGURATION 2 [1]

[1] SOME 69-12776 COWL RING ASSEMBLY INSTALLATIONS HAVE CONFIGURATION 2 SPLICE CONNECTION. ALL OTHER 69-12776 INSTALLATIONS HAVE CONFIGURATION 1 SPLICE CONNECTION.

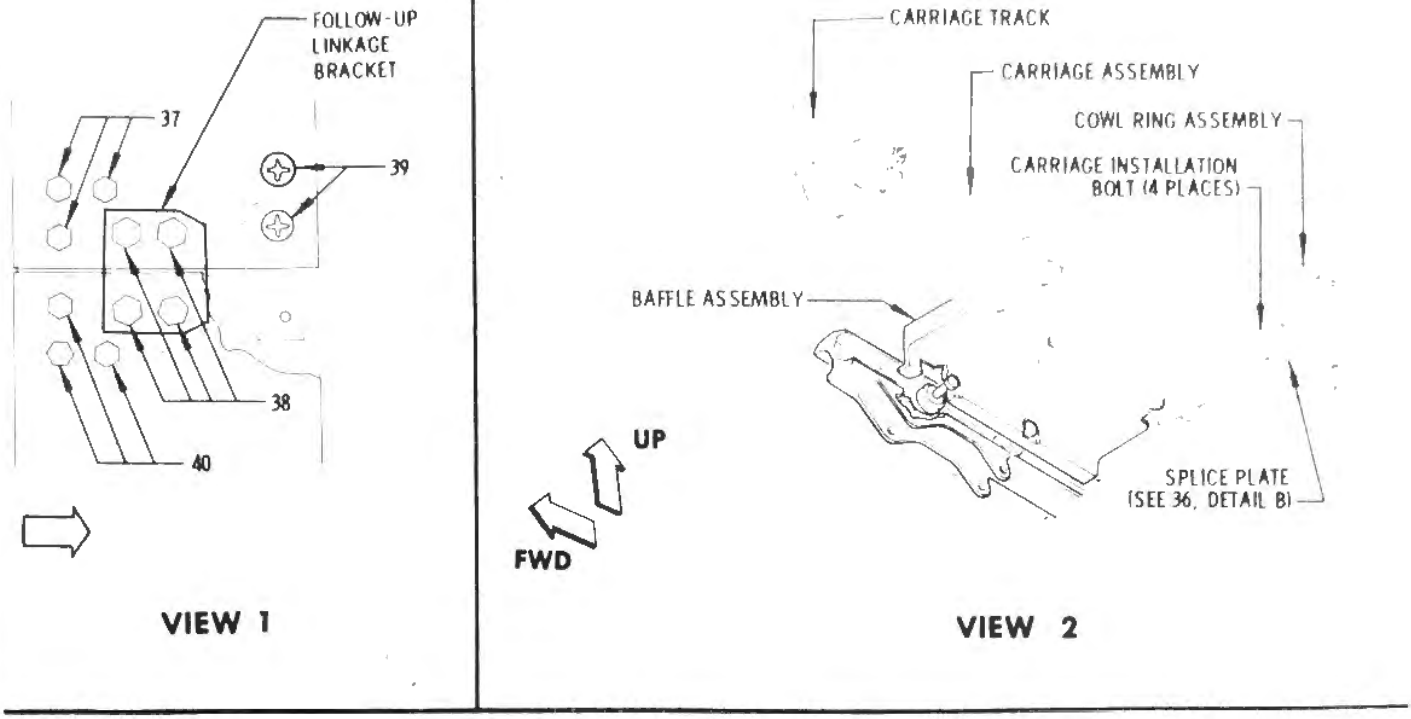


CONFIGURATION 3 [2]

27 UPPER SPLICE CONNECTION SCREWS - 6 NAS517-3-4
28 UPPER SPLICE CONNECTION SCREWS - 2 NAS517-3-3
29 UPPER SPLICE PLATE INSTALLATION SCREWS - 4 NAS517-3-2
30 UPPER SPLICE PLATE
31 UPPER SPLICE PLATE INSTALLATION SCREWS - 4 NAS517-3-4
32 UPPER SPLICE PLATE INSTALLATION SCREWS - 2 NAS517-4-13
33 UPPER SPLICE PLATE INSTALLATION SCREWS - 2 NAS517-4-16
34 UPPER SPLICE ANGLE
35 NUT - 2 NAS679-A3W
36 COWL RING UPPER SPLICE PLATE (REMOVE WITH CARRIAGE ASSEMBLY)
36A WASHER - 4 AN960PD416L [4]
36B NUT - 4 NAS679A4W [4]

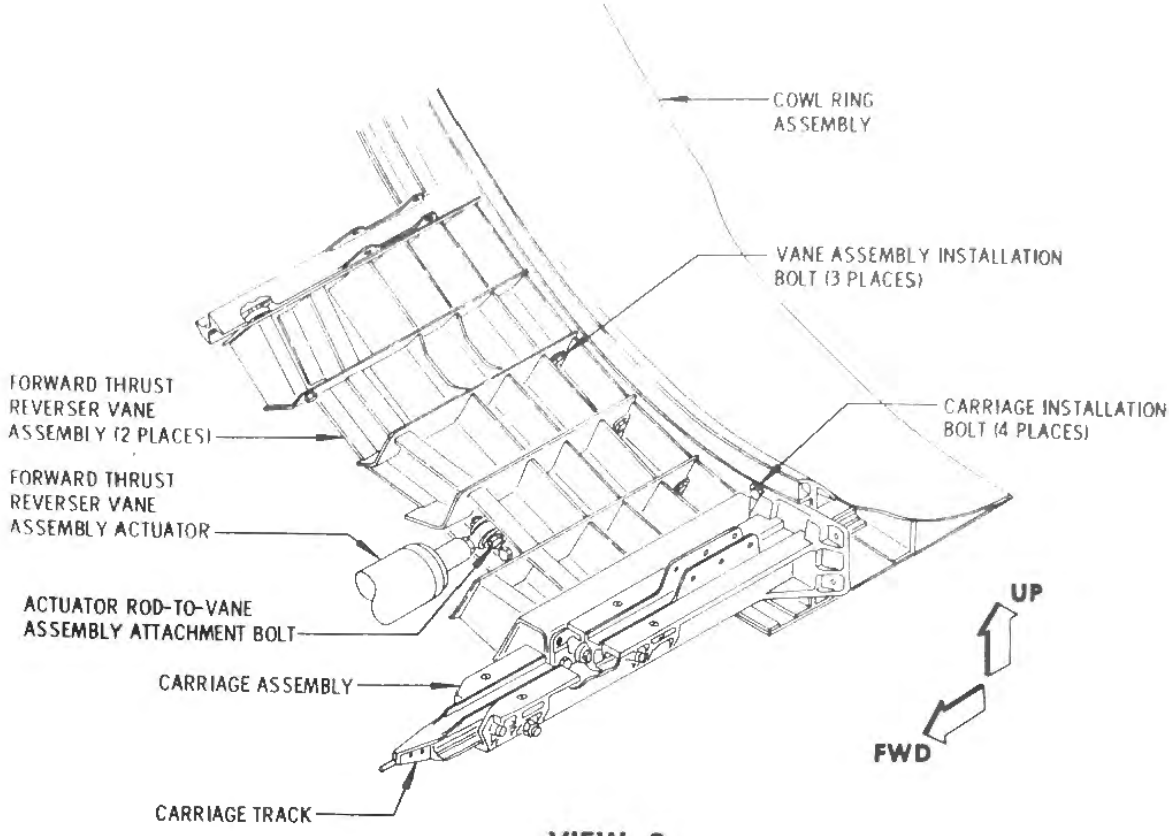
[2] APPLICABLE TO 65-57051 COWL RING ASSEMBLIES ONLY

[4] NUTPLATES USED INSTEAD OF NUTS AND WASHERS ON SOME ASSEMBLIES

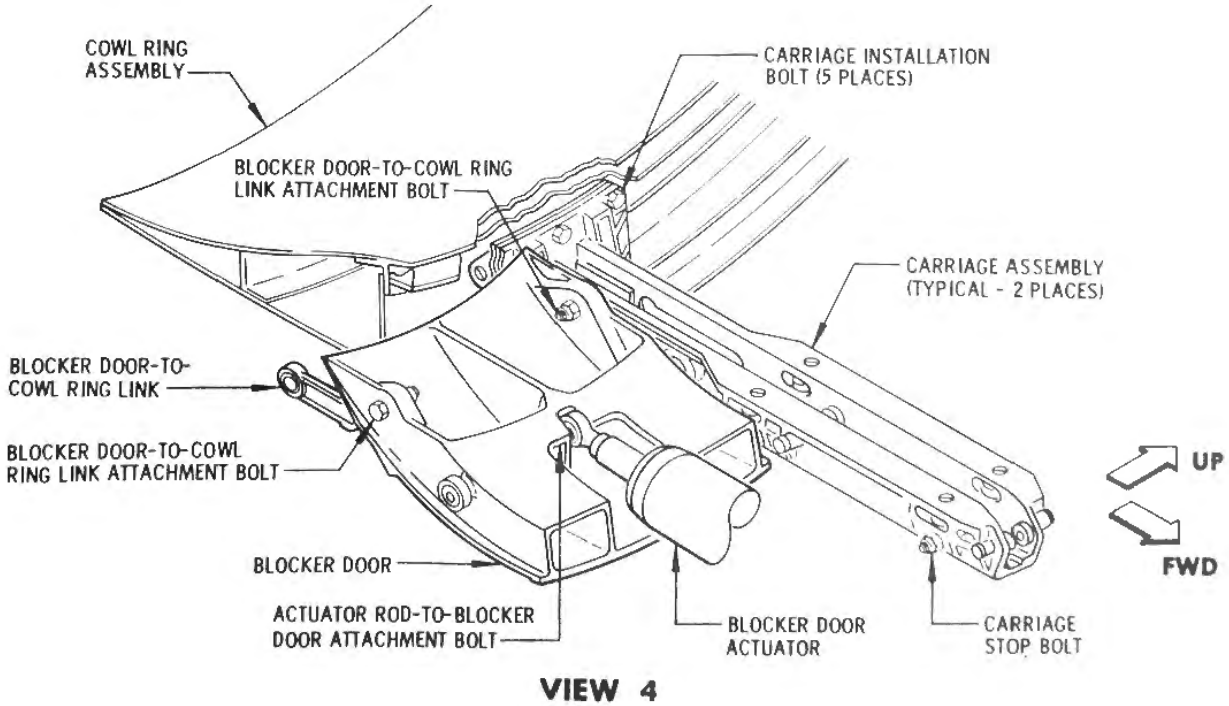


37 INNER TOP SPLICE INSTALLATION SCREWS - 3 NAS1303-3W
38 INNER TOP SPLICE INSTALLATION BOLTS (4 NAS1304-6) AND WASHERS (4 AN960-D416)
39 UPPER SPLICE CONNECTION SCREWS - 2 NAS517-3-5
40 INNER TOP SPLICE INSTALLATION BOLTS (3 NAS1303-3W) AND WASHER (3 NAS679-A3W)

Cowl Ring Assembly Installation
Figure 201 (Sheet 3 of 4)


COWL RING ASSEMBLY
VANE ASSEMBLY INSTALLATION BOLT (3 PLACES)
CARRIAGE INSTALLATION BOLT (4 PLACES)
FORWARD THRUST REVERSER VANE ASSEMBLY (2 PLACES)
FORWARD THRUST REVERSER VANE ASSEMBLY ACTUATOR
ACTUATOR ROD-TO-VANE ASSEMBLY ATTACHMENT BOLT
CARRIAGE ASSEMBLY
CARRIAGE TRACK
UP
FWD

VIEW 3


COWL RING ASSEMBLY
CARRIAGE INSTALLATION BOLT (5 PLACES)
BLOCKER DOOR-TO-COWL RING LINK ATTACHMENT BOLT
CARRIAGE ASSEMBLY (TYPICAL - 2 PLACES)
BLOCKER DOOR-TO-COWL RING LINK
BLOCKER DOOR-TO-COWL RING LINK ATTACHMENT BOLT
BLOCKER DOOR
ACTUATOR ROD-TO-BLOCKER DOOR ATTACHMENT BOLT
BLOCKER DOOR ACTUATOR
CARRIAGE STOP BOLT
UP
FWD

VIEW 4

(3) Remove two vane assemblies, located on either side of lower carriage assembly, from cowl ring assembly.

(a) Disconnect vane actuator from each vane assembly by removing actuator rod-to-vane attachment bolt. (See view 3.)

(b) Remove bolt, nut, and washer (3 places) attaching vane assembly to cowl ring.

(4) Remove installation bolts attaching cowl ring assembly halves together at splice connection at upper vertical centerline. (See detail B and view 1.)

(a) Remove screws (37, view 1), bolts (38), screws (39), and bolts (40) from nutplates at inner top splice.

(b) On airplanes having configuration 1 or configuration 2, remove nuts (35, detail B), and screws (27) and (28). On airplanes having configuration 3, remove nuts (35), and screws (27, 28, and 29).

(c) On airplanes having configuration 1, remove screws (30, 31, 32 and 33), upper splice plate (29) and upper splice angle (34). On airplanes having configuration 2, remove screws (30, 32, and 33), upper splice plate (29) and upper splice angle (34). On airplanes having configuration 3, remove screws (31, 32, and 33), upper splice plate (30), and upper splice angle (34).

(5) Remove installation bolts attaching cowl ring assembly halves together at splice connection at lower vertical centerline. (See detail A.)

(a) Remove nuts (19, detail A) screws (17), and splice plate (18).

(b) Remove bolts (23 and 24), washers (22), screws (25), and lower splice plate (26).

(c) Remove nuts (4), washers (3 and 13), screws (1, 2 and 6), and lower seal ring splice (21).

(d) Remove nuts (14), washers (20 and 16), screws (12 and 15) and lower splice angle (5).

(e) Remove bolts (9, 10 and 11), lower aft splice plate (7), and separate left and right hand ring assemblies (8).

(6) Lift cowl ring assembly halves away from engine.

C. Install Cowl Ring Assembly

(1) Position cowl ring halves on engine and assemble at splice connections at upper and lower vertical centerlines.

NOTE: Individual cowl ring assembly halves of 65-57051 and 65-11750 cowl ring assemblies are not interchangeable with units of other serial numbers. The sleeve assemblies are fabricated in matched sets to match the fan exhaust area and are serialized as a set.

(a) While manually maintaining alignment of ring assembly halves position lower aft splice plate (7, detail A, figure 201) and secure with bolts (9, 10 and 11).

(b) Position lower splice angle (5) at the lower, outer splice. Secure with screws (12 and 15), washers (20 and 16), and nuts (14).

(c) Position lower seal ring splice (21) at the lower, inner splice. Secure with screws (1, 2 and 6), washers (3 and 13), and nuts (4).

(d) Position lower splice plate (26), and secure with screws (25), washers (22), and bolts (23 and 24).

(e) Position splice plate (18) at the lower, outer splice. Secure with screws (17) and nuts (19).

(f) On airplanes having configuration 1, position upper splice angle (34, detail B) and upper splice plate (29), and secure with screws (30, 31, 32 and 33) at the top aft splice. On airplanes having configuration 2, position upper splice angle (34, detail B) and upper splice plate (29) and secure with screws (30, 32, and 33) at the top aft splice. On airplanes having configuration 3, position upper splice angle (34, detail B) and upper splice plate (30) and secure with screws (31, 32 and 33).

(g) On airplanes having configuration 1 or configuration 2 install screws (27 and 28) and nuts (35) at top outer splice. On airplanes having configuration 3 install nuts (35), and screws (27, 28 and 29).

(h) Install screws (37 and 39, view 2), bolts and washers (38), and bolts (40).

(2) Install 4 carriage assemblies, located at upper and lower vertical centerlines, and left and right horizontal centerlines, to cowl ring assembly.

(a) Attach carriage assemblies located on left and right horizontal centerlines and on lower vertical centerline of reverser to cowl ring assembly with 5 bolts. (See view 4.)

(b) Position splice plate between cowl ring and carriage assembly at upper vertical centerline and install 4 bolts through carriage assembly and splice plate. (See view 2.)

(3) Install two vane assemblies, located on either side of the lower carriage assembly, to the cowl ring assembly.

(a) Install with bolt, nut, and washer (3 places) at attachment brackets on cowl ring. (See view 3, figure 201.)

(b) Position actuator piston rod end between the flanges of the clevis attachment on the forward face of the vane assembly and attach with bolt, nut, and two washers. Install washers between rod end and flange on either side. Tighten nut until snug.

CAUTION: NUT MUST BE TIGHTENED CAREFULLY SO THAT BOLT HEAD AND NUT ARE JUST SEATED AGAINST THE FLANGES OF THE CLEVIS. OVER-TIGHTENING CAN CAUSE BENDING OF THE CLEVIS FLANGES WHICH MAY RESULT IN THEIR FAILURE.

(4) Connect blocker doors to cowl ring assembly. (See view 4.)

(a) Install blocker door-to-cowl ring links with bolt, nut, washer, and cotter pin (2 places) to blocker door attachment bosses, (2 places each door on twelve blocker doors).

(b) Attach blocker door actuator rod to blocker door rod attachment bracket.

(5) Adjust entire installation according to instructions given in 78-5-1, "Rig Fan Reverser Installation."

FORWARD THRUST REVERSER BLOCKER DOORS - MAINTENANCE PRACTICES

1. Removal/Installation Blocker Doors

A. General

(1) On some of the blocker door installations adjacent to the left and right hand side carriages, a one-half inch diameter hole has been added to the web at the reverser short tracks to allow removal of the blocker doors without removing the short track brackets.

B. Remove Blocker Door (See figure 201.)

(1) Move forward thrust reverser sleeve and blocker door into reverse thrust position.

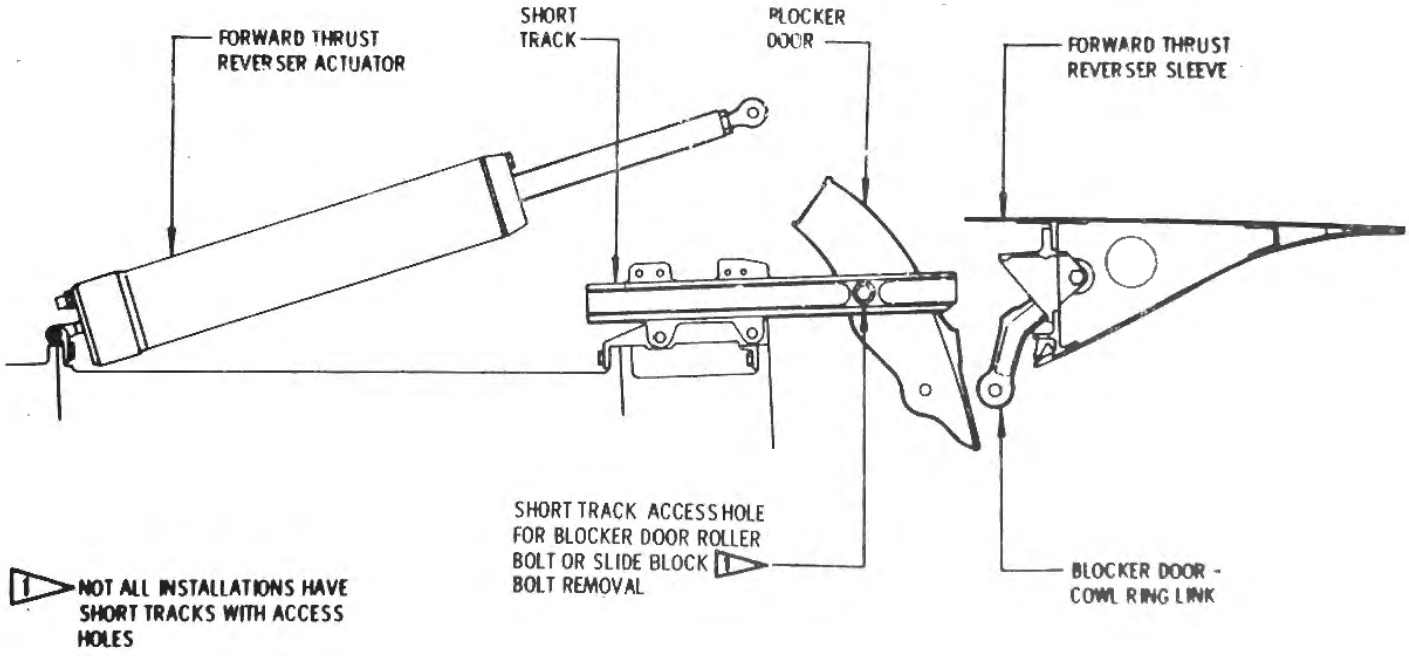
(2) On installations with short track access holes, proceed as follows:

(a) Pull the door to be removed forward until the door roller or slide block lines up with the hole in the short track web.

(b) Disconnect actuator rod end and blocker door cowl ring links from blocker door which is to be removed.

(c) Using an Allen Wrench through the access hole remove the roller retaining bolt or slide block retaining bolt.

(d) Remove blocker door by swinging it out of tracks.



(3) On installations adjacent to side carriages but not having short track access holes, proceed as follows:

(a) Disconnect actuator rod end and blocker door-cowl ring links from blocker door which is to be removed.

(b) Remove short track and track mounting bracket adjacent to blocker door.

(c) Remove blocker door.

(4) On all other installations proceed as follows:

(a) Disconnect cowl ring - blocker door links and actuator rod end at the blocker door.

(b) Slide the door out the front of the short tracks.

C. Install Blocker Door (See figure 201.)

(1) Maintain thrust reverser sleeve in same position as in paragraph B.

(2) On installations with short track access holes, proceed as follows:

(a) Position blocker door with roller through slot on side carriage onto long track and align blocker door so that roller or slide block attach point is lined up with short track access hole.

(b) Using an Allen wrench through the access hole install the roller or slide block with the retaining bolt. Use washers where required. Tighten nut within torque range of 20-28 pound-inches.

(c) Connect actuator rod end and blocker door - cowl ring links to blocker door.

(d) Rig blocker door installation per instructions in paragraph 2.B.(2) and 2.B.(3) of 78-5-1.

(3) On installations adjacent to side carriages but not having short track access holes, proceed as follows:

(a) Position blocker door roller in recess on short track and position track, track mounting bracket, and blocker door in place on engine with the other blocker door roller through side carriage slot and onto long track.

(b) Install short track and track mounting bracket.

(c) Connect actuator rod end and blocker door - cowl ring links to blocker door.

(d) Rig blocker door installation per instructions in paragraph 2.B.(2) and 2.B.(3) of 78-5-1.

(4) For all other blocker doors proceed as follows:

(a) Slide blocker door into recesses on tracks from forward end of tracks.

(b) Connect cowl ring - blocker door links and actuator rod end to blocker door.

(c) Rig blocker door installation per instructions in paragraph 2.B.(2) and 2.B.(3) of 78-5-1.

AFT THRUST REVERSER - MAINTENANCE PRACTICES

1. Removal/Installation Aft Thrust Reverser

A. General

(1) The aft thrust reverser, consisting of the thrust reverser assembly, tailpipe, and the aft thrust reverser sleeve may be removed from the engine as a single unit.

B. Equipment and Materials

(1) Antiseize compound, Fel-Pro C-5 or equivalent (Felt Products Mfg. Co., Chicago 7, Illinois) or Ease-Off 990 (Texacone Company, Dallas 8, Texas) or equivalent

(2) Air pressure source - 0 to 60 psig

(3) Thrust Reverser Cradle - F70141 or equivalent

(4) Fork Lift Truck - with 5 foot tines (for use with F70141)

C. Remove Aft Thrust Reverser

(1) Place thrust reverser in reverse thrust position.

(a) Connect air pressure source to ground service connection and regulate to 25 psig.

WARNING: GROUND AIR SUPPLY MUST NOT BE CONNECTED UNLESS THE ENGINE SIDE COWL PANELS ARE COMPLETELY CLOSED, AND FAN COWL PANELS REMOVED, TO AVOID STRUCTURAL OR ENGINE DAMAGE OR INJURY TO PERSONNEL.

(b) Move applicable reverse thrust lever in control cab aft to interlock position. Check that thrust reverser has moved aft to reverse thrust position.

WARNING: PERSONNEL MUST STAY CLEAR OF ENGINE WHEN THRUST REVERSER IS BEING ACTUATED. A PLACARD SHOULD BE PLACED ON CONTROL STAND WARNING AGAINST ACTUATION OF THRUST LEVERS WHILE PERSONNEL ARE WORKING ON THRUST REVERSER.

(c) Disconnect ground air supply.

(2) Disconnect lower actuator support link at thrust reverser connection by removing cotter pin, nut, bolt (1, view 2, figure 201A), and bushing (2 places).

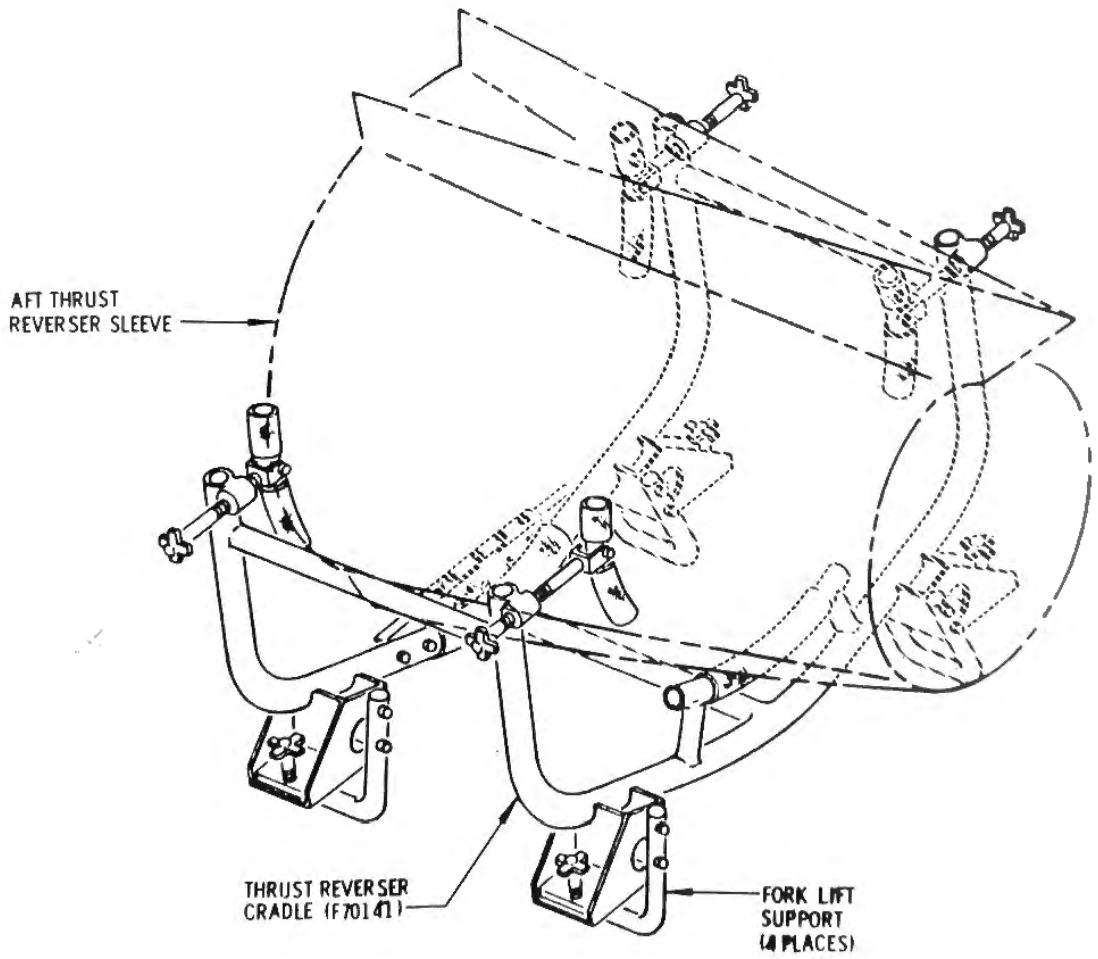
(3) Remove nut and bolt (2) connecting sleeve lower track to actuators.

(4) Disconnect lower actuator rod ends from lower actuators truck assembly by removing cotter pin, nut, bolt (3), and two bushings (2 places).

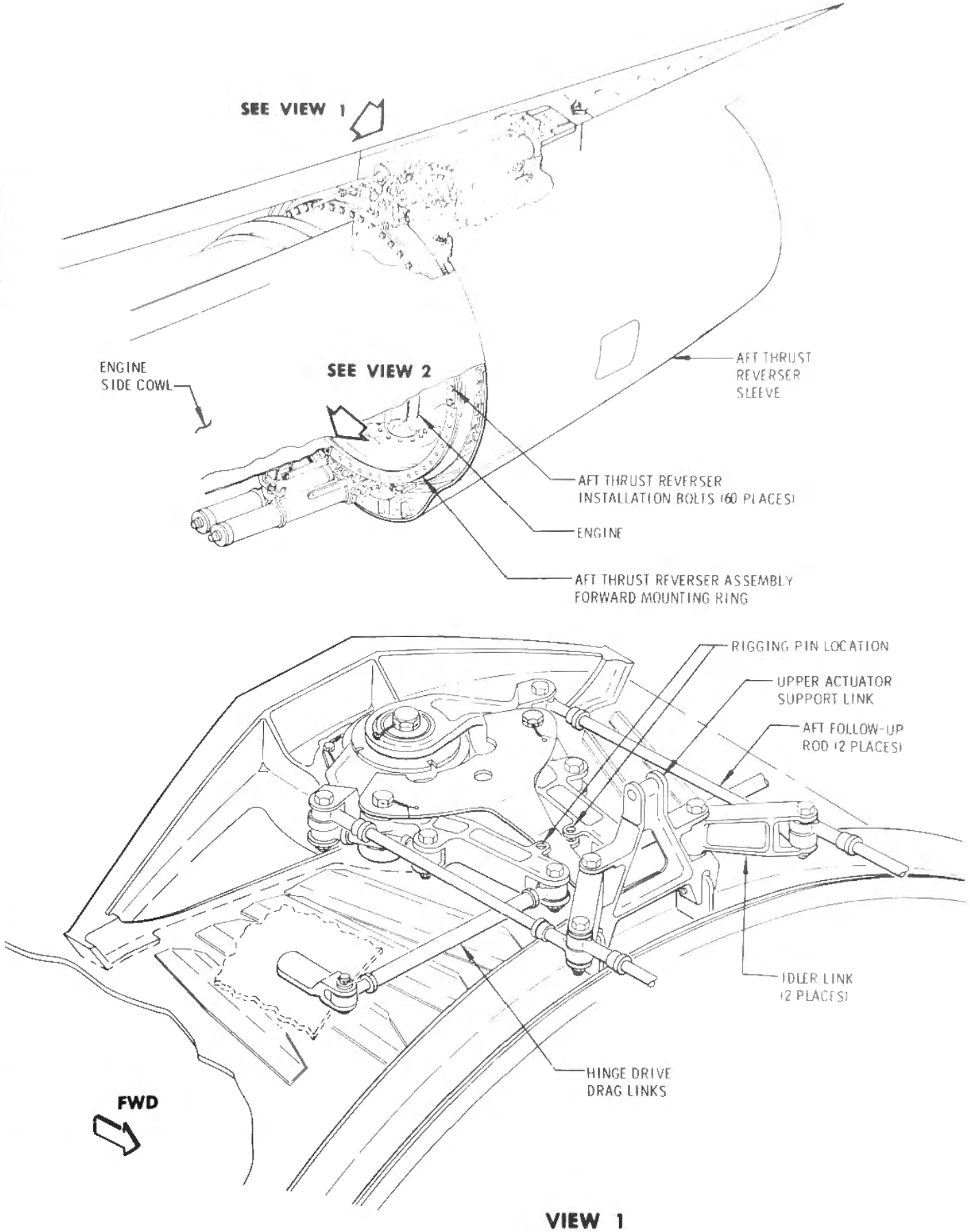
(5) Disconnect lower actuator lock from actuators assembly at actuator attach lugs (2 places) by removing bolt 2 places. This will allow hook to rotate about lock actuator rod end, and hang below lock actuator.

NOTE: This step necessary when using F70141 cradle to provide clearance for sleeve retaining lip across bottom of forward tubular support on cradle.

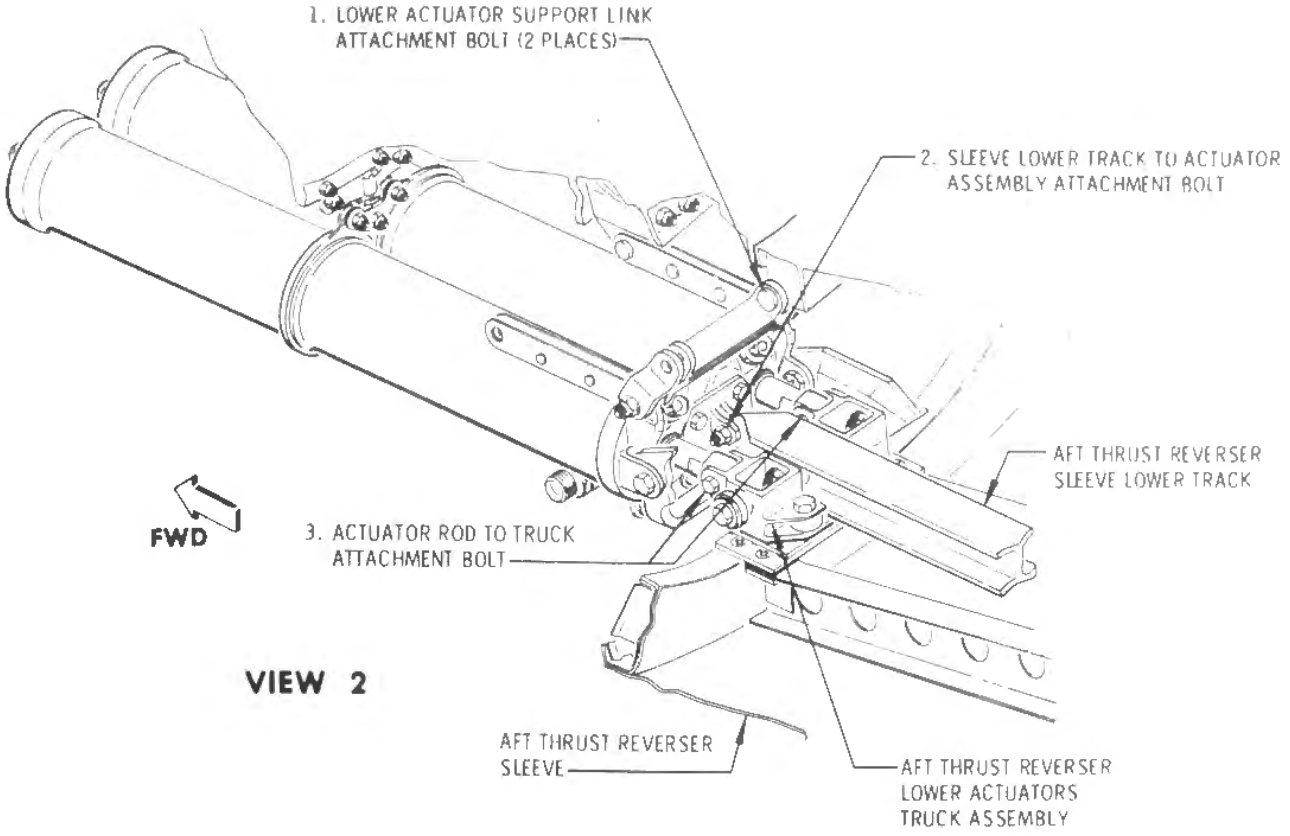
(6) Disconnect upper actuator (including lock actuator) tubing (4 places) at forward end of actuators.



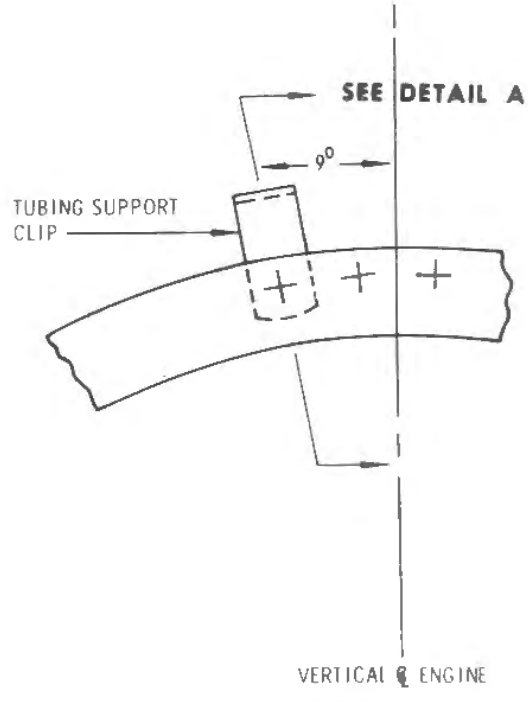
Attachment of Cradle (F70141) to Aft Thrust Reverser Sleeve
Figure 201


SEE VIEW 1
ENGINE SIDE COWL
SEE VIEW 2
AFT THRUST REVERSER SLEEVE
AFT THRUST REVERSER INSTALLATION BOLTS (60 PLACES)
ENGINE
AFT THRUST REVERSER ASSEMBLY FORWARD MOUNTING RING
RIGGING PIN LOCATION
UPPER ACTUATOR SUPPORT LINK
AFT FOLLOW-UP ROD (2 PLACES)
IDLER LINK (2 PLACES)
HINGE DRIVE DRAG LINKS
FWD

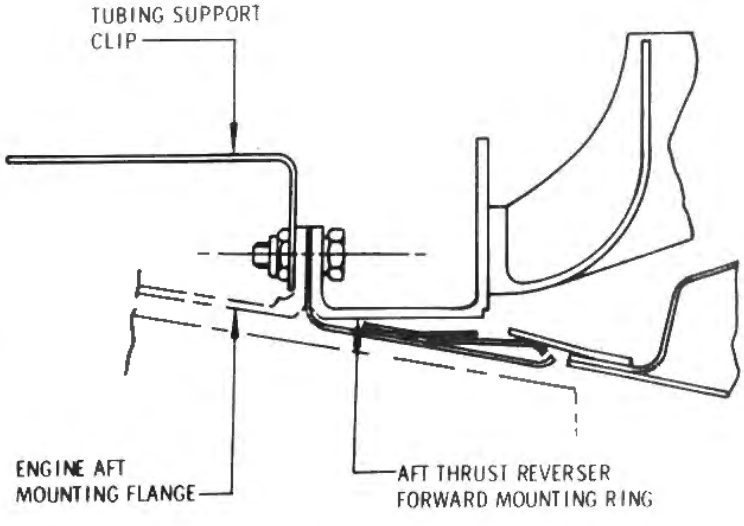
VIEW 1



VIEW 2



VIEW 3



DETAIL A

Aft Thrust Reverser Installation
Figure 201A (Sheet 2 of 2)

(7) Disconnect aft follow-up rod assemblies (2 places) at upper actuator support link by removing nut and bolt (2 places) holding rod assemblies to idler links. (See view 1.)

(8) Disconnect system wiring at lower left-hand side of thrust reverser assembly.

(9) Manually position sleeve to cruise position.

(10) Secure thrust reverser cradle, F70141, to aft thrust reverser as shown in figure 201 and position fork lift truck at supports on cradle to take load of thrust reverser, and secure lifts to supports.

CAUTION: WHEN INSTALLING OR REMOVING THRUST REVERSER FROM OUTBOARD SIDE OF ENGINE, CRADLE MUST BE SECURED TO FORK LIFT TRUCK BY CHAINS OR OTHER SUITABLE MEANS. THIS IS NECESSARY BECAUSE THE ENGINES HANG AT A 7° ANGLE TO THE VERTICAL DUE TO THE DIHEDRAL ANGLE OF THE WING.

CARE MUST BE EXERCISED WHEN POSITIONING CRADLE WITH FORK LIFT TRUCK TO PREVENT DAMAGE TO THRUST REVERSER SLEEVE, ENGINE, OR STRUT.

(11) Remove bolts (60 places) around thrust reverser forward support ring.

CAUTION: CHECK THAT THRUST REVERSER CRADLE HAS ASSUMED THRUST REVERSER LOAD BEFORE REMOVING ALL BOLTS.

D. Install Aft Thrust Reverser (See figure 201.)

(1) Coat threads and shank of all bolts and screws with anti-seize compound prior to installation.

(2) With thrust reverser cradle, F70141, secured to aft thrust reverser sleeve as shown in figure 201, position thrust reverser on rear of engine using fork lift truck.

CAUTION: WHEN INSTALLING OR REMOVING THRUST REVERSER FROM OUTBOARD SIDE OF ENGINE, CRADLE MUST BE SECURED TO FORK LIFT TRUCK BY CHAINS OR OTHER SUITABLE MEANS. THIS IS NECESSARY BECAUSE THE ENGINES HANG AT A 7° ANGLE TO THE VERTICAL DUE TO THE DIHEDRAL ANGLE OF THE WING.

CARE MUST BE EXERCISED WHEN POSITIONING CRADLE WITH FORK LIFT TRUCK TO PREVENT DAMAGE TO THRUST REVERSER SLEEVE, ENGINE, OR STRUT.

(3) Attach thrust reverser to engine at thrust reverser assembly forward mounting ring by installing bolts (60 places). Attach tubing support clip at location shown in view 3. Bolt threads must completely penetrate nuts. (See figure 202.)

NOTE: Obtain proper positioning of thrust reverser by lining up lower actuator support link to attaching points at bottom of thrust reverser frame. (See view 2, figure 201.)

(4) Remove cradle, F70141.

(5) Reposition aft sleeve to reverse thrust position.

(6) Connect lower actuator lock by rotating it into position about lock actuator rod end and attaching with two bolts (4, view 1) at attach lugs on actuator assembly.

(7) Install lower sleeve track by bolt (2) and nut to lower actuators at mounting flanges on aft end of actuators. (See view 2, figure 201.)

(8) Install lower actuator rod ends to lower truck assembly with 2 bushings, bolt (3), nut, and cotter pin (2 places).

(9) Attach lower actuator support link to actuator with bolt (1), nut, bushing, and cotter pin (2 places).

(10) Connect thrust reverser pneumatic lines at forward end of upper actuator. Tighten coupling nut at connection of pneumatic line to welded manifold cross fitting to 350 to 400 pound-inches torque.

CAUTION: DO NOT EXCEED 350 TO 400 POUND-INCHES TORQUE ON ANY WELDED FITTINGS ON THE MANIFOLD. DAMAGE TO FITTINGS MAY RESULT IF THIS TORQUE IS EXCEEDED.

(11) Connect aft follow-up rods (2 places) to idler link at upper actuator support link. (See view 1, figure 201.)

(12) Connect wiring at lower left side of aft thrust reverser assembly.

(13) Return aft thrust reverser sleeve to cruise position.

(14) Adjust entire installation per paragraph 2.

2. Adjustment/Test Aft Thrust Reverser

A. Equipment and Materials

(1) Three 0.150 inch thick gage blocks to match surface of rub strip

B. Adjust Aft Thrust Reverser

(1) Remove aft thrust reverser sleeve access panels L3708, R3708, L3710, R3710, and 3711. (See figure 201.)

(2) Disconnect lower actuators at their rod end connection to sleeve mounted carriage (6:00 o'clock position). Disconnect upper actuators at their rod end connection to sleeve structure. Gain access to upper thrust reverser actuator rod connections through aft thrust reverser sleeve access panels, L3708 and R3708. (See figure 202.)

(3) Disconnect drag links (4 places) connecting actuator hinge idler links to thrust reverser sleeve. Disconnect at sleeve end of rods. (See figure 201.)

(4) Disconnect forward follow-up rods at cable drum yoke connection. (See figure 202, view 1.)

(5) Insert a 0.15 inch spacer or gage block in the 12:00, 3:00, and 9:00 o'clock positions between the skid plates of the tailpipe and the sleeve. Move sleeve as far forward as it will go, jamming the spacers between tailpipe and sleeve at locations noted.

(6) With main side cowl panels installed, check for alignment between upper exterior surface of sleeve and cowl. A maximum step or gap of ± 0.01 inch should exist between cowl surface and sleeve at upper surface only as shown in figure 202.

(a) Add or subtract as necessary the same amount of shims at the upper or lower roller carriage trucks to attain the ± 0.01 inch gap as specified above. (See details A and F.) Prior to tightening bolts at these locations, center sleeve at 3:00 and 9:00 o'clock positions relative to engine case and thrust reverser.

NOTE: Serrated plates at upper and lower roller carriage attach points will fix sleeve position upon tightening carriage attach bolts.

(7) With spacers installed per step (5), adjust aft sleeve support carriages (view 3).

(a) Gain access to sleeve support carriages through access panel locations L3708, R3708, L3710, R3710, and 3711 located halfway back on sleeve at 12:00, 3:00, 6:00 and 9:00 o'clock positions.

(b) Adjust the four carriages such that the large rollers spanning the sleeve track may be turned by hand (no load). Set adjustment nuts and safety.

(c) Fore and aft motion of the sleeve shall be free without sticking or binding throughout its full travel. If binding exists, check for chips, nuts, bolts, etc., trapped in sleeve tracks.

(7A) With cowl panels off and 20 psig applied to rod ports of each actuator, adjust strut stops such that the vertical gap between sleeve and strut skin is 0.04 (± 0.01) inch at forward end of sleeve. (See figure 202.)

(8) On airplanes having sleeve fairing alignment provisions as called out on detail H and J, proceed as follows. On all other airplanes proceed to step (9).

NOTE: Airplanes having sleeve fairing adjustments may be identified by alignment attachment bolts located on either side of aft sleeve fairing in recess cutout in side of fairing as shown in detail J.

(a) With side cowl panels off and sleeve in position per step (5), check that aft end of sleeve fairing centers vertically with strut fairing within 0.03 inch. If sleeve and strut fairings do not align, adjust sleeve to attain proper alignment as follows:

1) Check that access panels L3708 and R3708 are removed so that aft section of sleeve fairing is free to rotate on its hinges.

2) Remove two bolts attaching aft sleeve fairing to aft sleeve at anchor fitting (4) at upper inner surface of sleeve at aft end. (See detail J.)

3) Swing movable portion of fairing to one side as shown in detail H, to gain access to alignment adjustments.

4) Remove bolts (1, detail J) and pull assembly consisting of anchor fitting (4), pin (6), washers (2), spacers (3) and (5), pin (6) and washers (7) free from sleeve fairing. Remove shim. Rearrange washers (2) and, if necessary, spacers (3 and 5) to obtain 0.03 inch vertical alignment of sleeve fairing and strut fairing with anchor fitting attachment bolts inserted through anchor fitting and sleeve attachment holes.

5) With assembly adjusted and in position with shim between sleeve and anchor fitting, install and lockwire bolts (1) and secure sleeve to sleeve fairing with 2 bolts and 2 radius fillers. (See detail J.)

(9) With sleeve in full forward position per step (5), connect upper and lower actuator rod ends to sleeve structure attach points.

(a) Install upper actuator rod and eccentric bushing so that rod is in uppermost position relative to cylinder centerline (hole in bushing down).

(b) Install lower actuator rod and eccentric bushings so that rod is centered as nearly as possible in cylinder at both extremes of sleeve travel.

1) On airplanes having lower actuator forward support hanger as shown in configuration 1, (Section A-A) additional adjustment is obtained by backing off jam nuts on either side of hanger, and raising or lowering actuators as required. Secure jam nuts to hanger in new location and lockwire.

2) On airplanes having lower actuator forward support hanger as shown in configuration 2, no additional adjustment is required.

(10) With rigging pins installed in hinge drive idler arms as shown in figure 201 (thrust reverser assembly rigged according to overhaul manual instructions prior to assembly with sleeve and installation on engine), connect the 2 upper and the 2 lower hinge drive drag links to thrust reverser hinge drive idler links and sleeve.

(11) Connect aft thrust reverser follow-up rods to yoke at follow-up cable drum. Adjust the rods such that the yoke is 90° to strut horizontal centerline with rig pin installed in follow-up drum.

NOTE: The two aft follow-up rods between the thrust reverser hinge idler and the follow-up system idler are pre-set to 9.76 inches and should not be adjusted during rigging.

(12) Remove four rigging pins from reverser hinge idler arms and one rigging pin from follow-up cable drum. Replace access panels.

C. Test Aft Thrust Reverser

(1) Place forward thrust lever in idle position and reverse thrust lever in off position for applicable engine.

(2) Connect external air source to ground service connection in strut and regulate to 25 psig. (See 78-6-0, figure 202, view 2.) Gain access to ground service connection through access panel 1739 or 3716, depending on type of engine.

(3) With side cowl panels on check that side cowl panels and aft thrust reverser sleeves are flush at top and bottom within ± 0.01 inch.

(4) With side cowl panels open, check that gap on horizontal centerline between the cascade vane assemblies and forward ring of sleeve is equal on each side.

(5) Check that there is no preload on aft track roller installation (4 places). Gain access to aft track rollers by removing access panels L3708, R3708, L3710, R3710 and 3711 located at horizontal and vertical centerlines of aft thrust reverser sleeve.

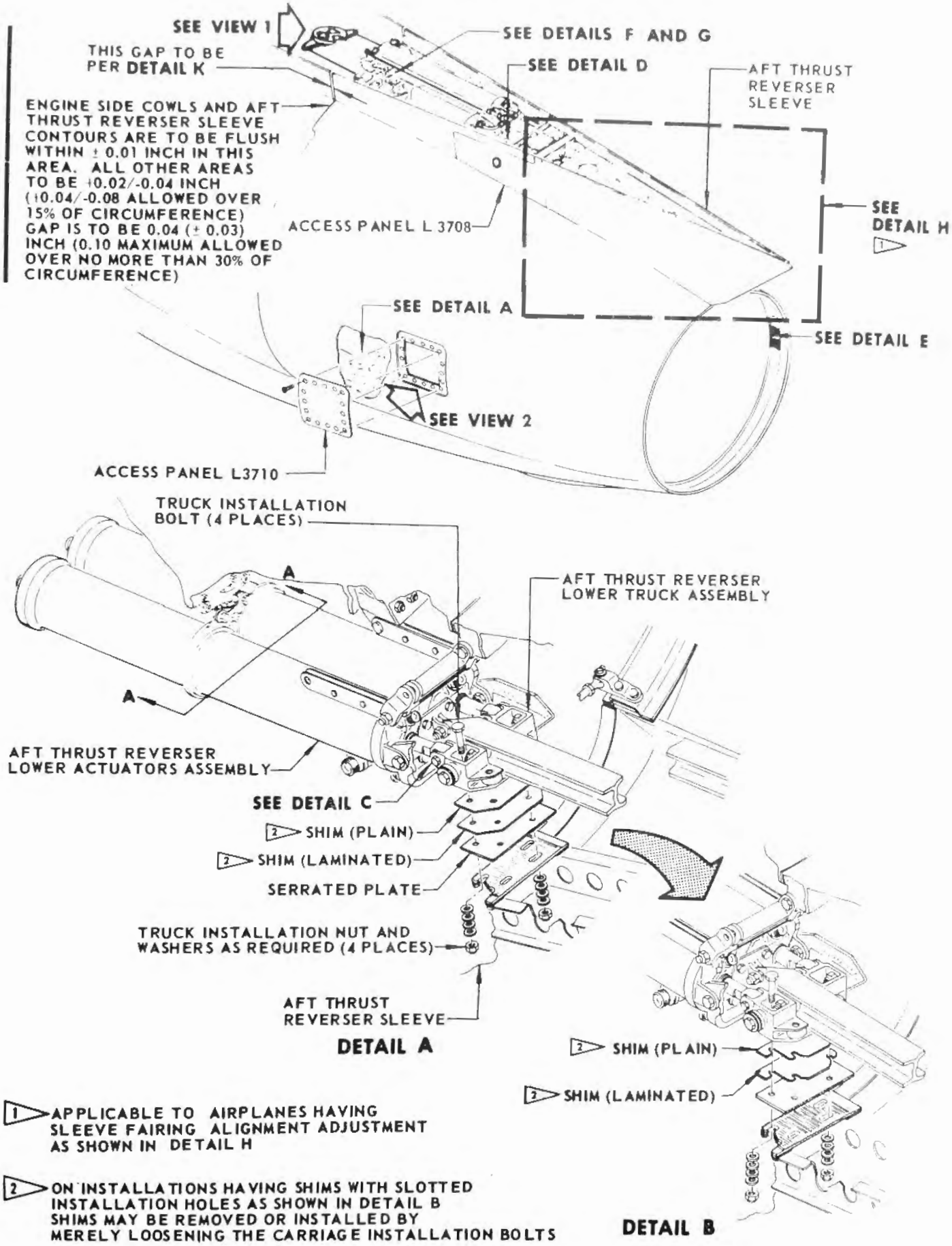
(6) Check that vertical gap between sleeve and strut skin is 0.04 (± 0.01) inch at forward end of sleeve.

(7) Bring forward thrust lever back to the idle position and then actuate the reverse thrust lever aft to either the interlock or the full reverse thrust position. The aft thrust reverser sleeve shall move to reverse thrust position.

(8) Move reverse thrust lever forward to the idle position. The clamshell doors shall go to full forward thrust position and be firmly seated in the seals.

CAUTION: WHEN RETURNING THE THRUST REVERSER TO CRUISE POSITION USING GROUND AIR THE FORWARD THRUST REVERSER SLEEVE MUST BE HELD IN THE AFT POSITION UNTIL ALL THE BLOCKER DOORS HAVE ROTATED TO THE "CRUISE" OR FAIRED POSITION. THIS MAY BE DONE BY USING A RESTRAINT HARNESS, BOEING PART NO. MIT65-10621, OR EQUIVALENT. AS AN ALTERNATE METHOD THE SLEEVE MAY BE RESTRAINED MANUALLY BY A MECHANIC ON EACH SIDE OF THE SLEEVE PUSHING AFT ON THE SLEEVE DURING THE RETRACT CYCLE UNTIL ALL THE BLOCKER DOORS HAVE ROTATED TO THE CRUISE POSITION. THE MECHANICS SHOULD EXERCISE CAUTION TO PLACE THEIR HANDS ON THE SLEEVE IN THE LOWER AREA ADJACENT TO THE FIXED VANE ASSEMBLIES TO PREVENT THEIR HANDS BEING HIT BY THE ROTATING BLOCKER DOORS.

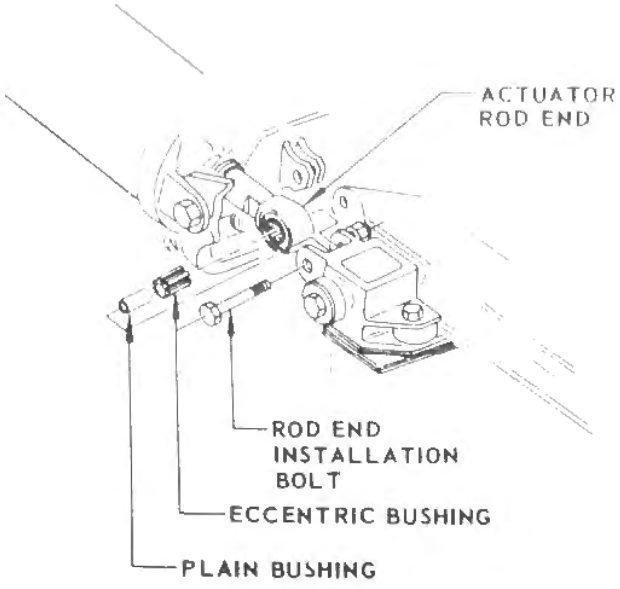
(9) Remove air pressure source, recap ground connection and replace access panels.



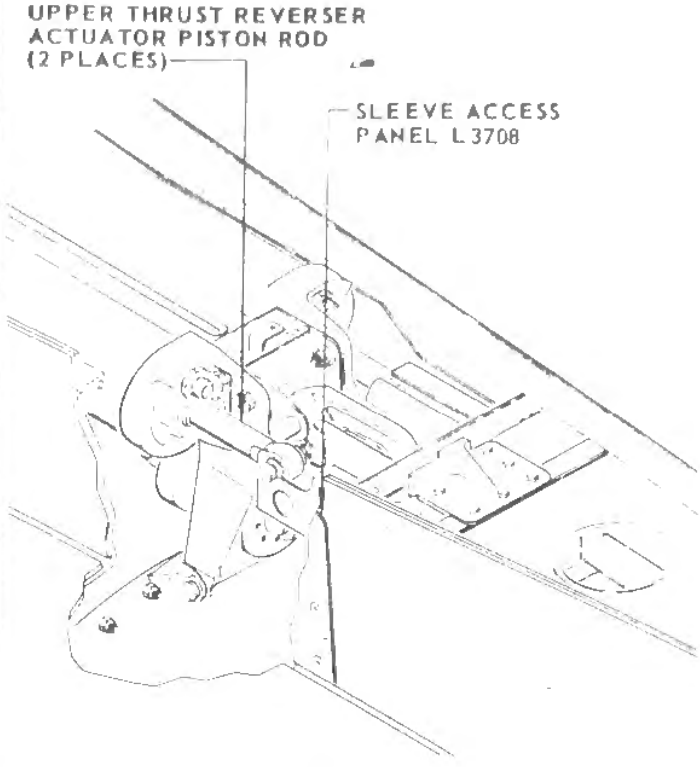
1 APPLICABLE TO AIRPLANES HAVING SLEEVE FAIRING ALIGNMENT ADJUSTMENT AS SHOWN IN DETAIL H

2 ON INSTALLATIONS HAVING SHIMS WITH SLOTTED INSTALLATION HOLES AS SHOWN IN DETAIL B SHIMS MAY BE REMOVED OR INSTALLED BY MERELY LOOSENING THE CARRIAGE INSTALLATION BOLTS

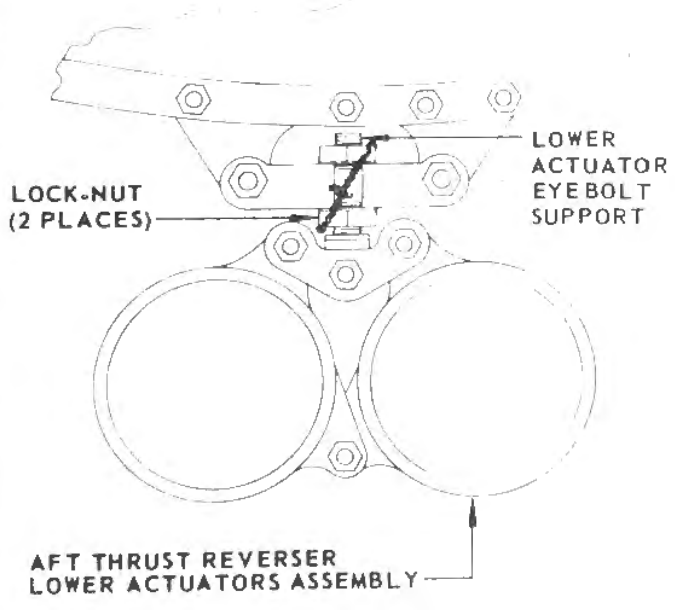
Aft Thrust Reverser Installation Rigging
Figure 202 (Sheet 1)



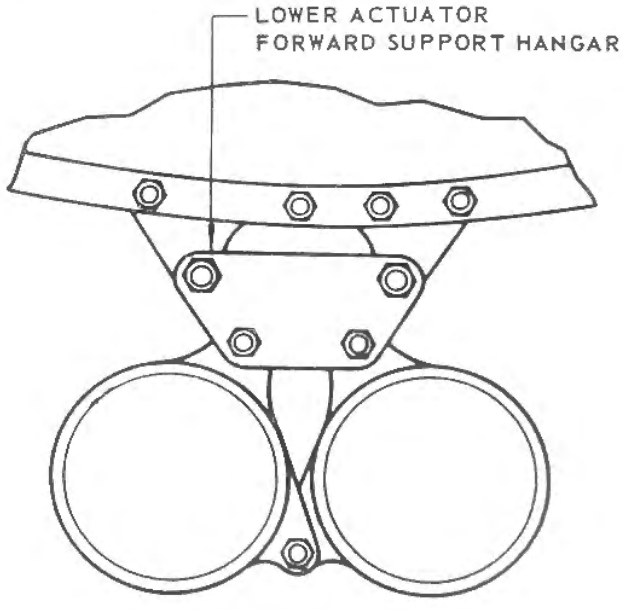
DETAIL C



DETAIL D

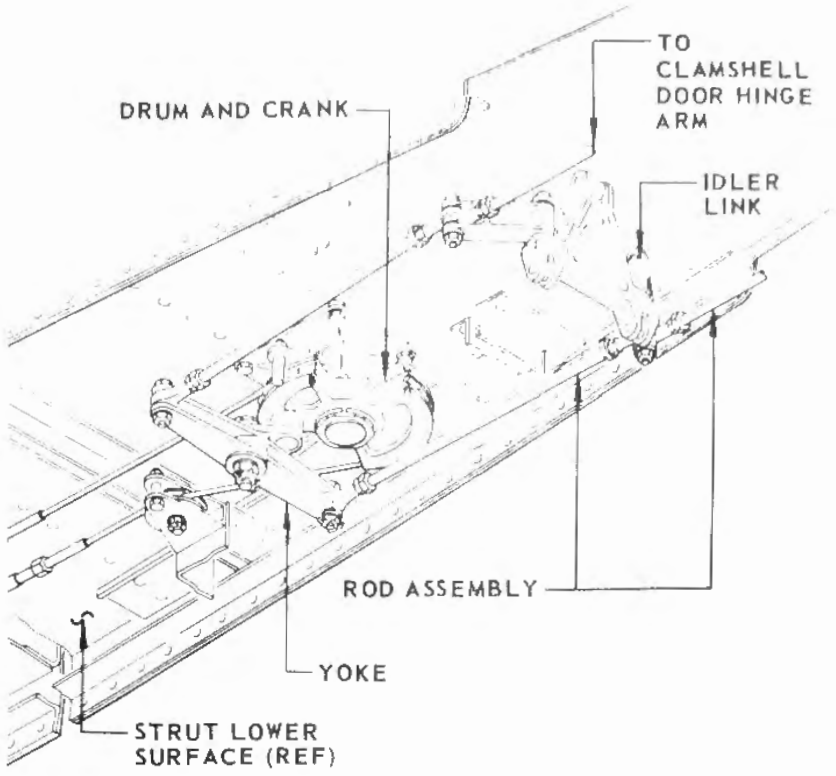


CONFIGURATION 1

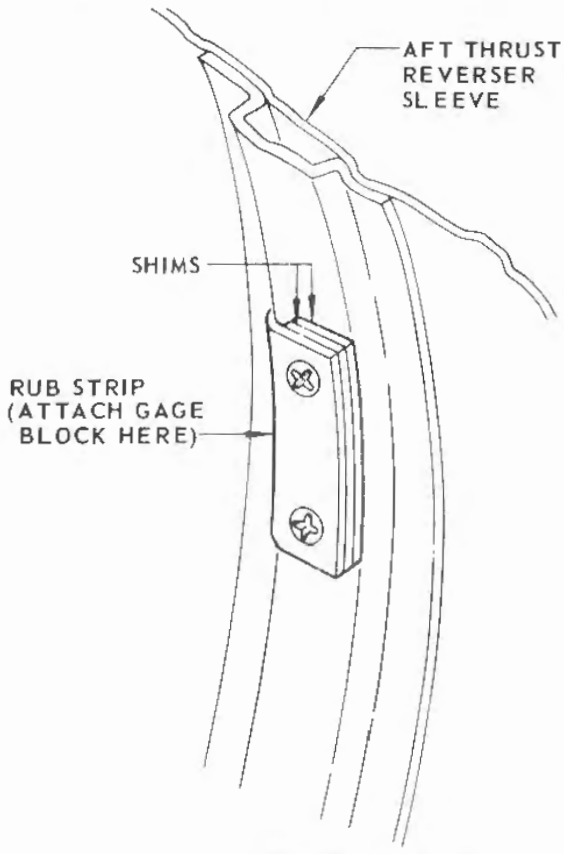


CONFIGURATION 2

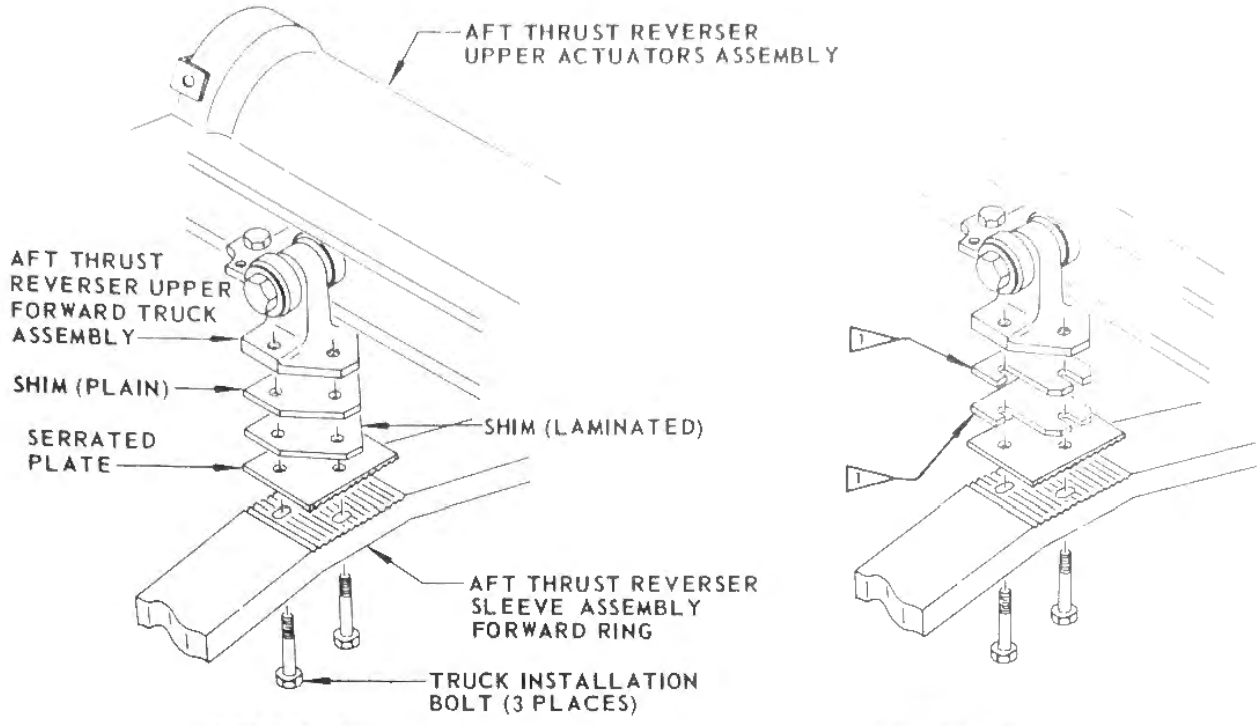
A - A



VIEW 1



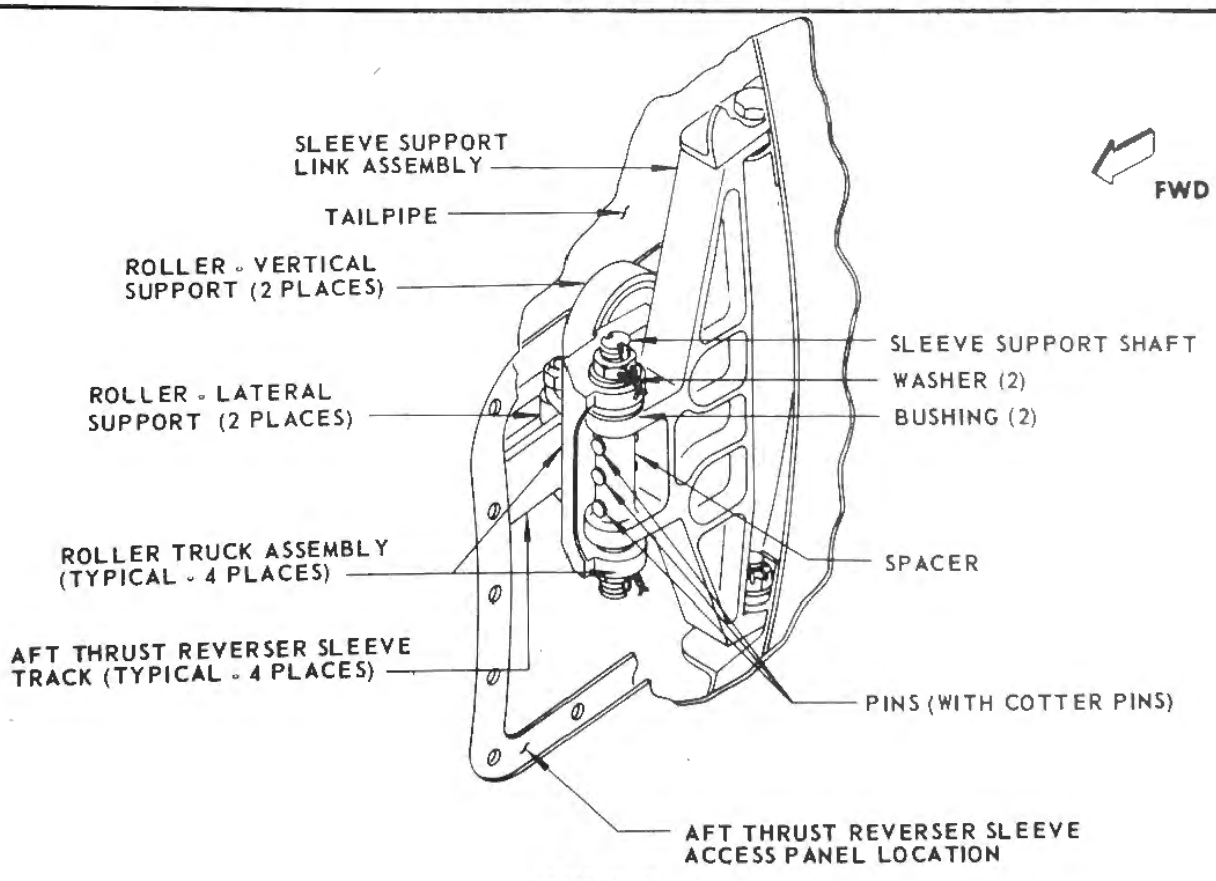
DETAIL E



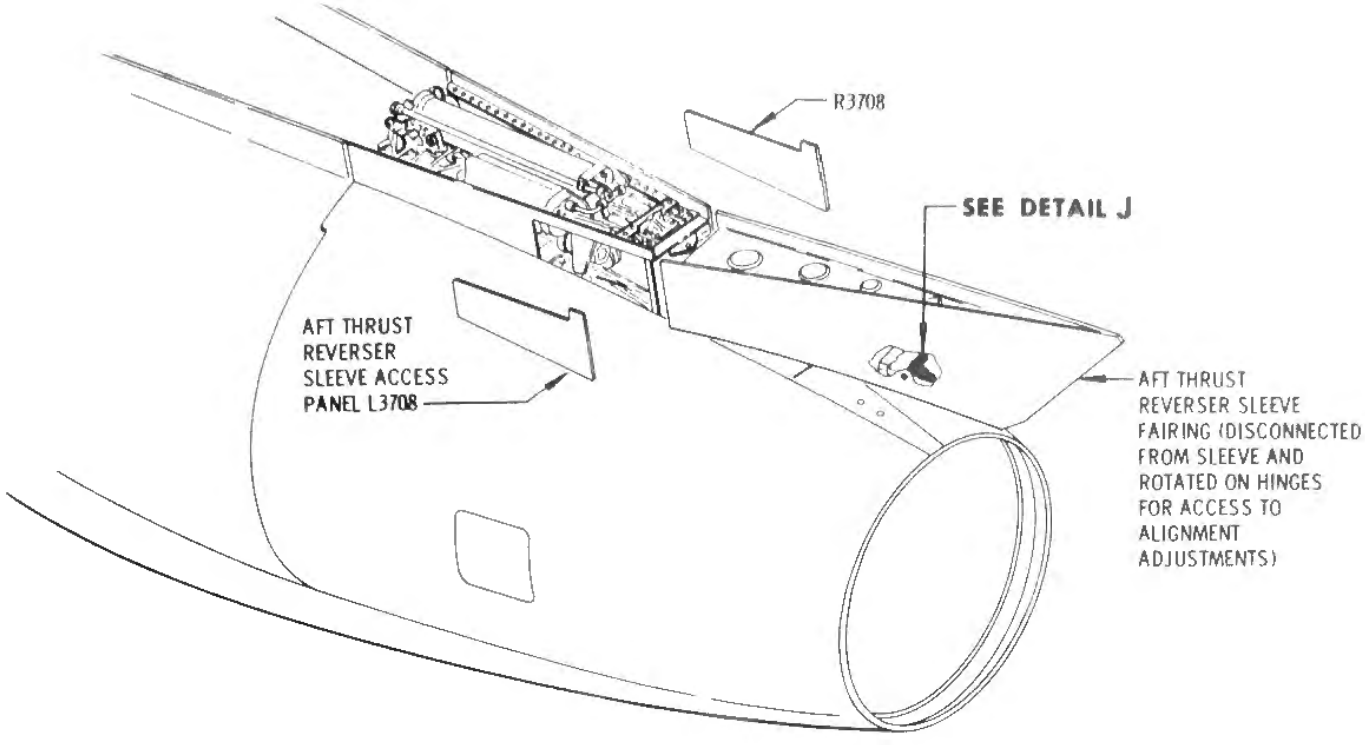
DETAIL F

DETAIL G

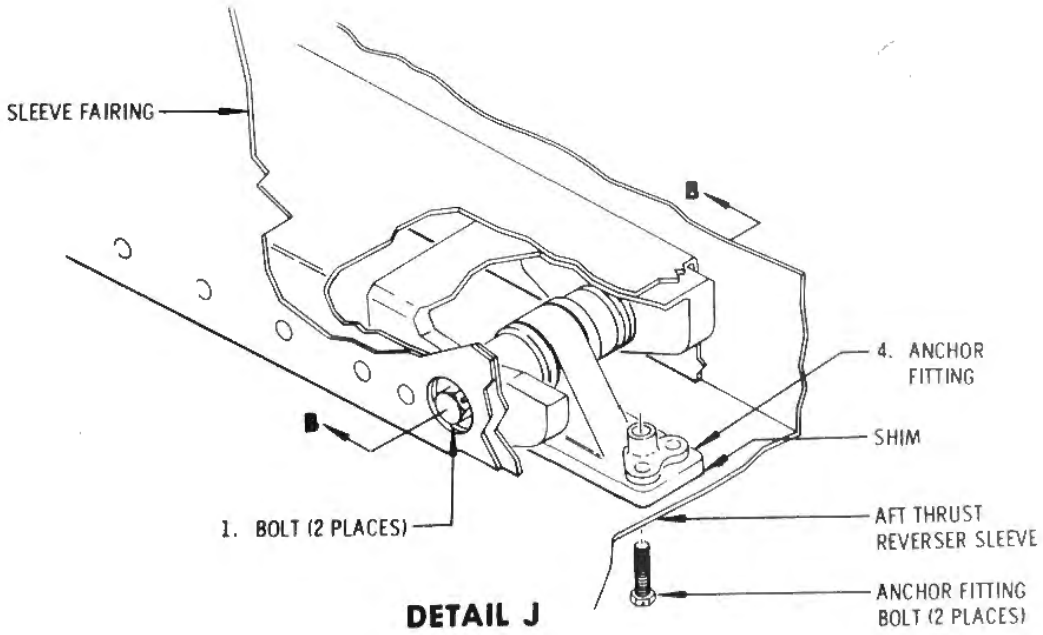
1 ON INSTALLATIONS HAVING SHIMS WITH SLOTTED INSTALLATION HOLES AS SHOWN IN DETAIL G SHIMS MAY BE REMOVED OR INSTALLED BY MERELY LOOSENING THE CARRIAGE INSTALLATION BOLTS



VIEW 2



DETAIL H



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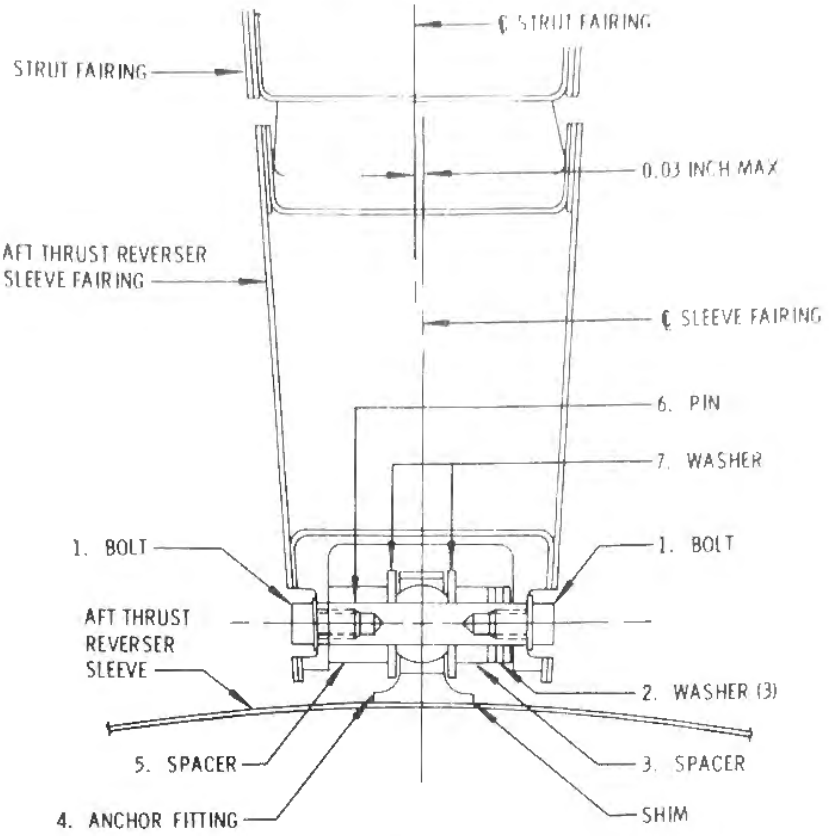
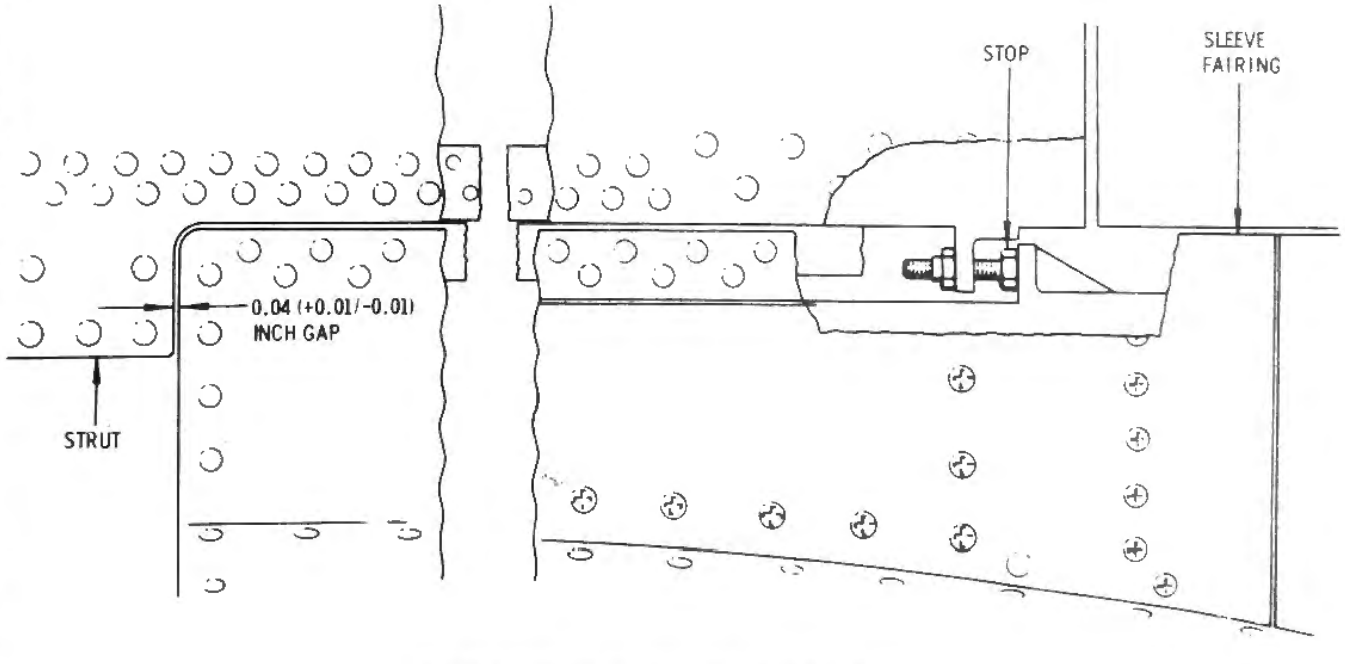


B - B

SLEEVE FAIRING TO STRUT FAIRING ALIGNMENT PROVISIONS



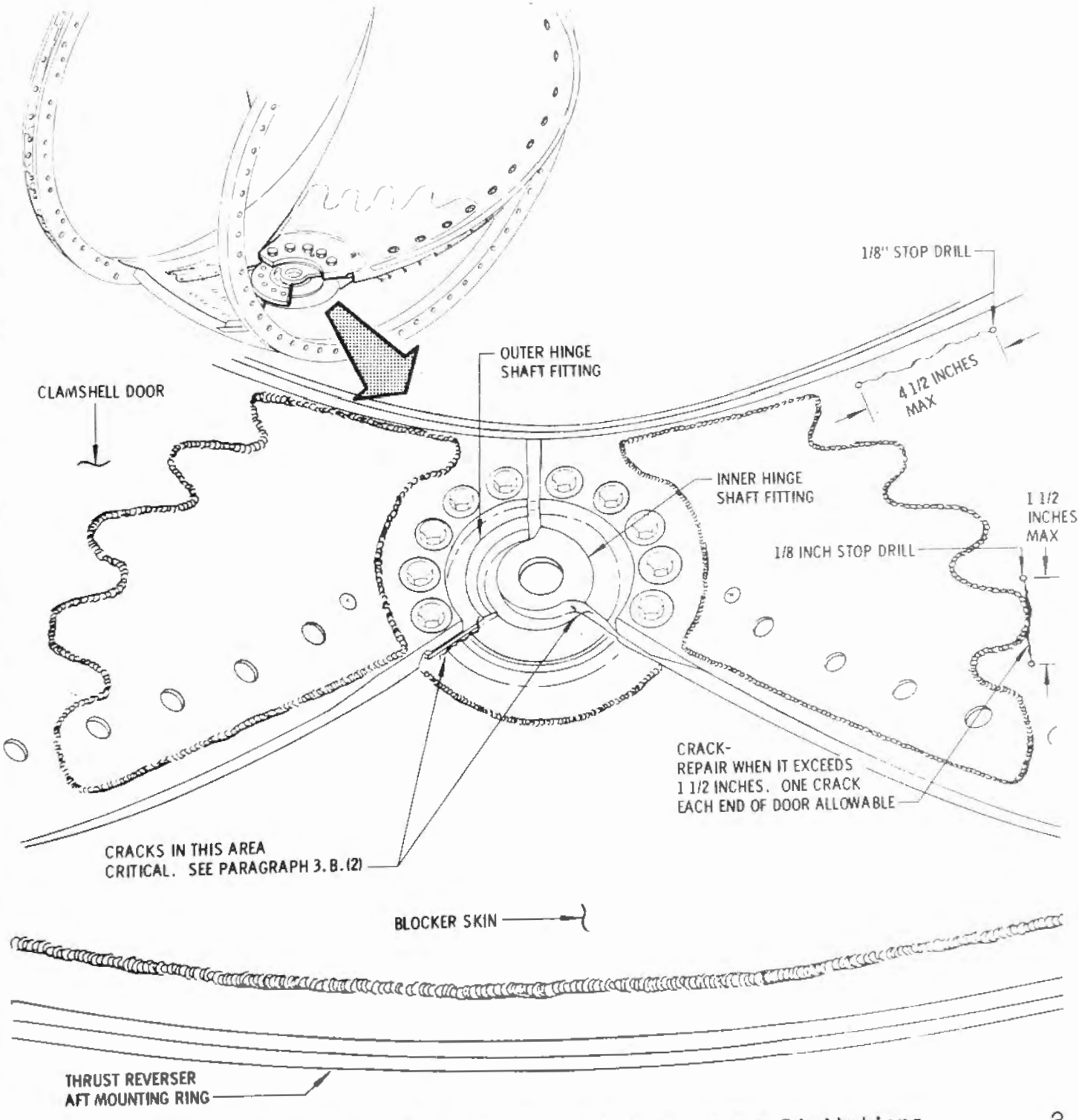
ADJUSTMENT OF AFT REVERSER STOP

DETAIL K

3. Inspection/Check Aft Thrust Reverser

A. General

(1) Inspection of the thrust reverser consists mainly of the following: checking for cracks and wear of the thrust reverser components, checking for proper seal contact, checking for missing seal leaves on the seal assemblies, checking for missing or loose rivets in the aft thrust reverser translating sleeve, and checking for freedom of movement of the translating sleeve.



Clamshell Door Hinge Area and Hinge Fitting Crack Limitations
Figure 203

B. Check Clamshell Doors

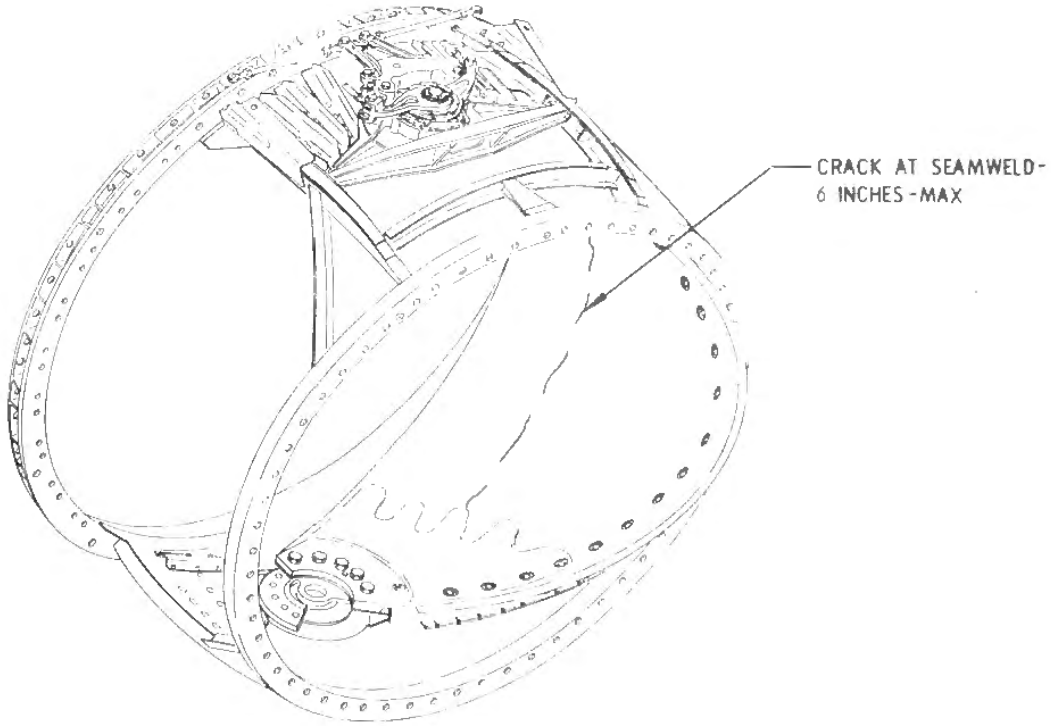
(1) Visually inspect the clamshell doors for cracking or distortion. (See figure 203.)

(a) Cracks in the inner skin of the door adjacent to the finger-like doubler at the hub area and located in a fore-and-aft direction may be stop-drilled. A maximum of one crack up to 1-1/2 inches in length at each door finger double location is considered tolerable before repair.

(b) Cracks at the seam weld between the door and the leading edge seal contact angle up to 4-1/2 inches in length are considered tolerable before repair is required.

(2) Visually inspect the clamshell door hinge shaft fitting for cracks. Particular attention should be given to the machined fillet area between the shaft and the flange edge at the clamshell door trailing edge plane. Replace thrust reverser if hinge support fitting crack exceeds 0.75 inch. (See figure 203.) If crack does not exceed 0.75 inch, the thrust reverser may be continued in service, but not in operation, for a maximum of 25 flight hours before replacement.

NOTE: Frequent inspection of the hinge shaft fitting is necessary to preclude the possibility of hinge shaft failure and loss of the clamshell door itself.



Typical Cracks Clamshell Door
Figure 204

(3) Examine inner skin of clamshell door for seamweld cracks. (See figure 204.) Cracks at the seamweld between the door inner skin and the internal stiffening structure up to 6.00 inches long are considered tolerable before repair.

NOTE: Wrinkling of the door inner skin between the supporting stiffeners is not considered detrimental to door strength or function.

(4) With the doors in the reverse thrust position, inspect the gap between the Left Hand and Right Hand doors. A gap of 5/16 inches is considered tolerable before repair.

(5) Visually inspect the clamshell door seals for contact with their mating surfaces or for missing seal leaves. This check is to be made with the thrust reverser in the "cruise" position and 75 psig applied at the ground service connection.

(a) Connect ground air supply.

1) Place forward and reverse thrust levers at idle and placard control stand to warn against actuation of thrust levers when personnel are working on thrust reverser.

2) Remove engine side cowl panels and fan cowl panels.

CAUTION: GROUND AIR SUPPLY MUST NOT BE CONNECTED UNLESS THE ENGINE SIDE COWL PANELS ARE REMOVED OR COMPLETELY CLOSED AND FAN COWL PANELS REMOVED, TO AVOID STRUCTURAL OR ENGINE DAMAGE OR INJURY TO PERSONNEL.

3) Connect air source to ground air connection located in strut. Gain access to ground service connection through access panel 3716 or 1739 located in strut. See Chapter 12, "Access Doors and Panels."

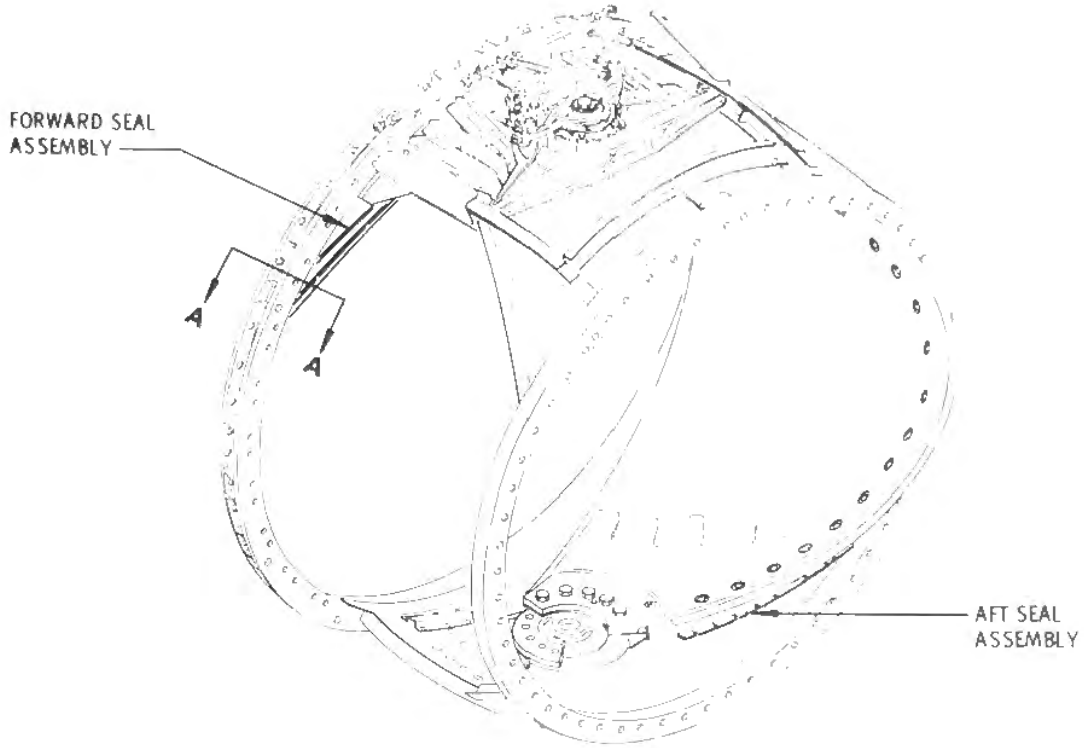
NOTE: Supply line between the ground air supply pressure regulator and the ground air connection shall have a minimum inside diameter of 9/32 of an inch.

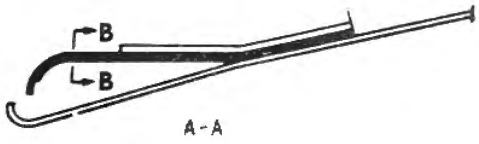
(b) Regulate pressure source to 75 psig.

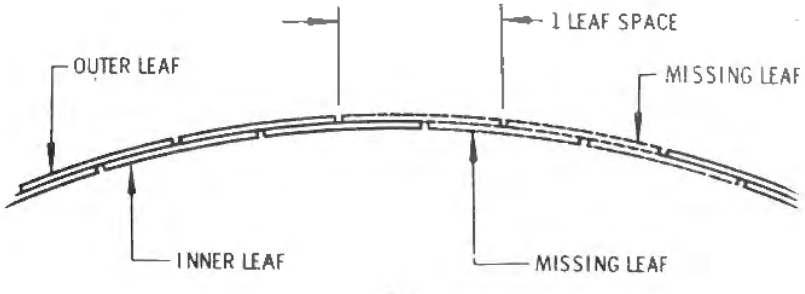
(c) Check clamshell doors for at least a 50 per cent contact between both the forward seal assembly and its contact area and the aft seal installations on the doors and their contact area on the frame.

(d) The loss of one or the other of two overlapping seal leaves on either the forward or aft seal assemblies is permissible. (See figure 205.)

(e) The loss of both inner and outer overlapping seal leaves totaling a maximum of six leaf spaces in the contact area of the forward seal assembly with the clamshell door or in the contact area of the aft door seals is considered tolerable.

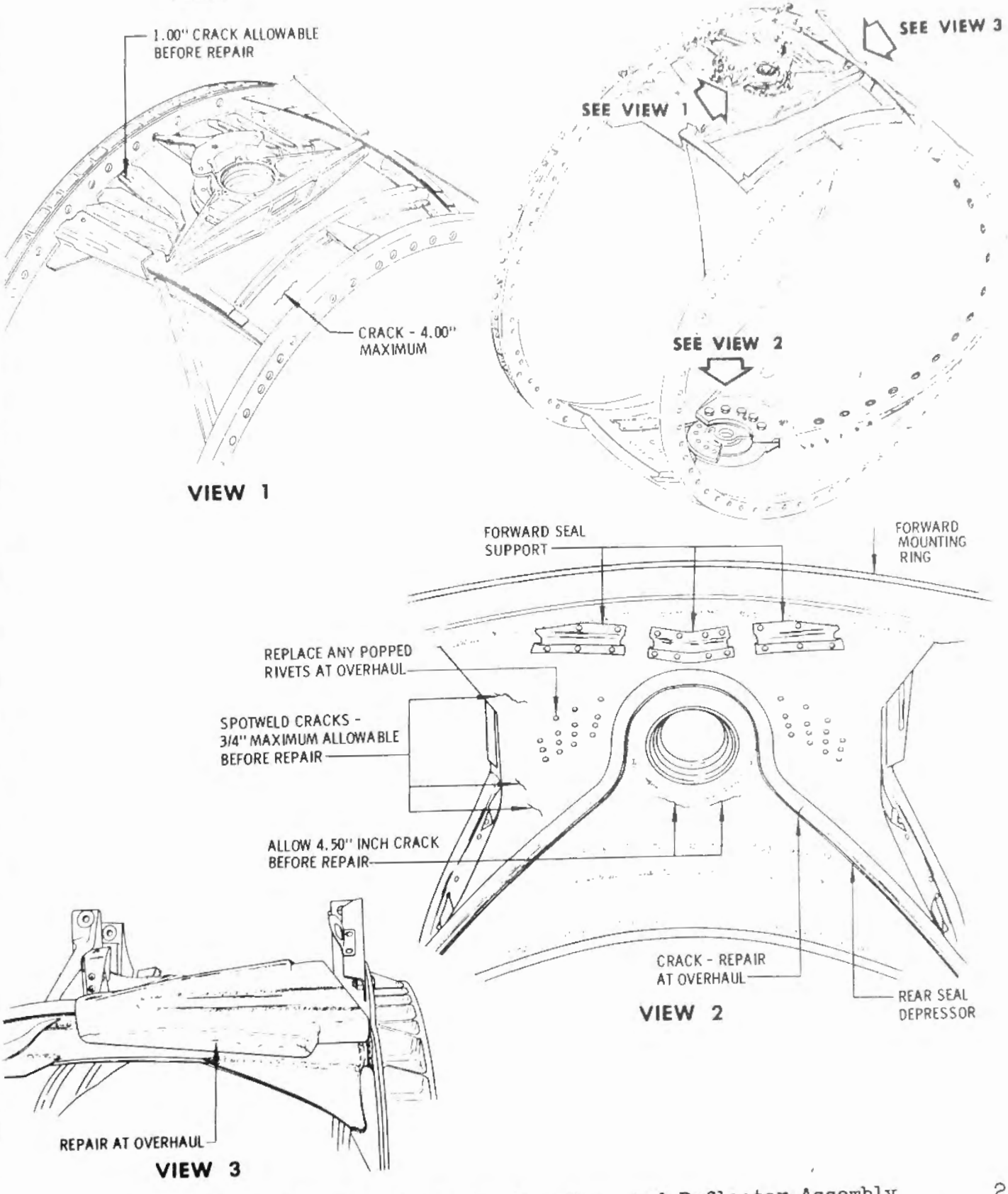






(f) Cracks in the aft door seal depressor angle are not considered detrimental to effective sealing. (See figure 206, view 2.)

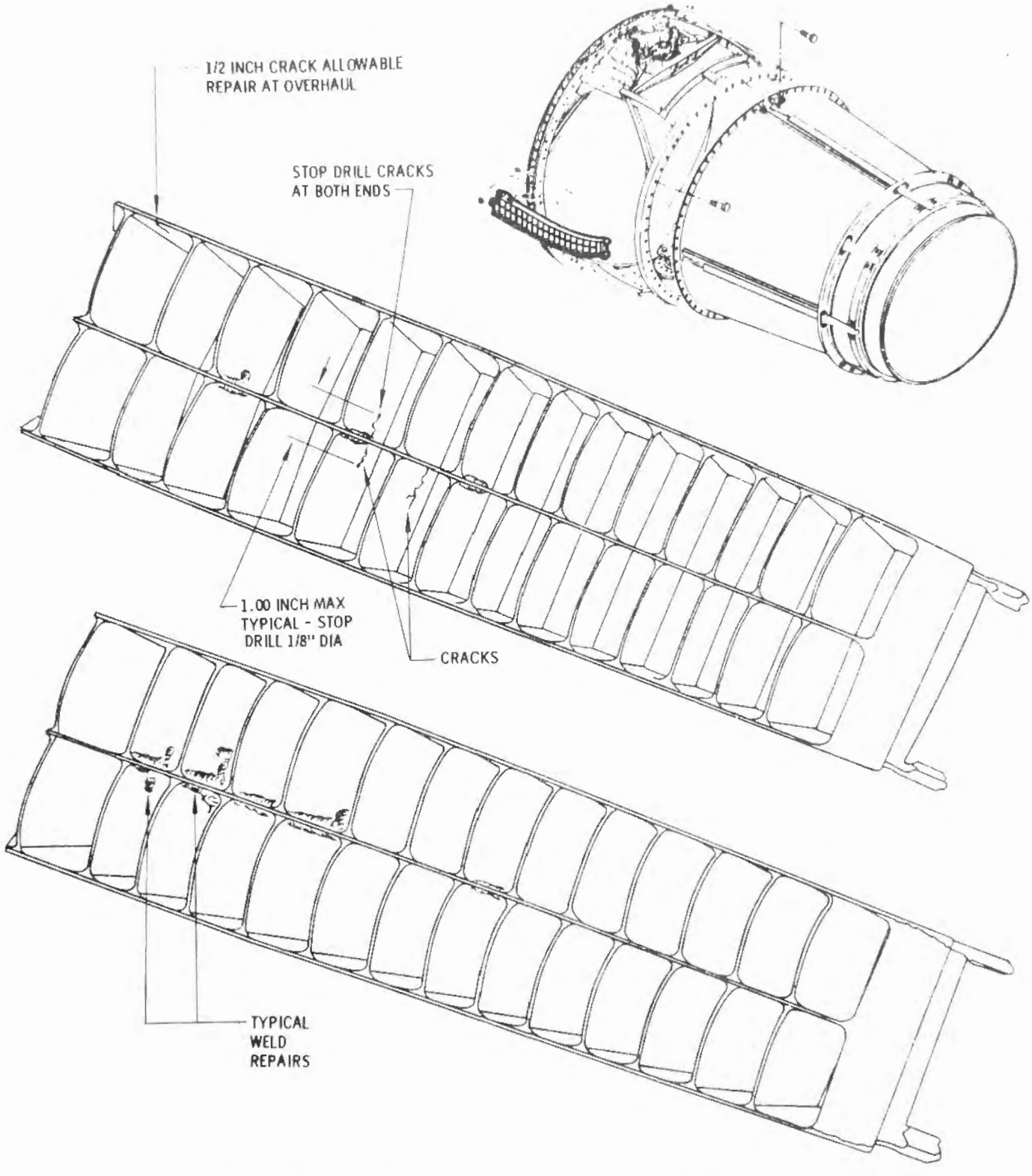
(6) Check for evidence of clamshell door interference with the cascade vanes.



Typical Crack Limits and Repair Data Ring and Deflector Assembly
Figure 206

(7) Visually check the cascade vane assemblies for cracks and missing vanes. (See figure 207.)

(a) Cracks in a vane or blocker assembly up to 1.00 inch in length are allowable before repair is required. Stop drill (1/8 inch dia) and continue in service until overhaul.



Typical Cascade Vane Assembly Crack Limits and Repair Data
Figure 207

(b) Cracks in the side strongbacks up to 1/2 inch in length are considered to be tolerable before repair.

NOTE: Repair is recommended when these limits are reached due to the possibility of sleeve damage upon retraction from reverse to cruise thrust.

(c) Operation of the thrust reverser with one or two missing vanes in a cascade vane assembly is permissible. This is considered allowable to a maximum of two missing vanes per vane assembly in a total of four vane assemblies. The unit may be operated to overhaul with the above limits.

(8) Check actuators and linkages for freedom of movement.

(a) Check actuators by moving piston rod and note if "floating gland" of actuator is free at both ends of travel. Move rod through its travel and check for binding. Check all rod end bearings for freedom of movement.

(b) Check for galled or worn parts. Replace where found.

(9) Examine tailpipe and aft sleeve carriage trucks.

(a) Check for cracks in tailpipe. Stop drill (1/8-inch dia) upon discovery. Repair per Overhaul Manual when crack exceeds four inches in length or if there are more than two cracks. No more than one crack is allowable in any of the four main skin areas bounded on either side by the tailpipe tracks.

(b) Check for freedom of roller carriage trucks to roll along tracks. (Lift up on trailing edge.)

(c) Check track for galling and grind smooth if local depth exceeds 0.03 inches.

NOTE: Some brinelling may occur where rollers rest in cruise position but rework is not required if thrust reverser operation is satisfactory. See 78-6-0, "Adjustment/ Test Thrust Reverser."

(10) Check lower surface of strut

(a) Check sleeve stop for bent or damaged stop bolt. Replace and re-rig as required. (See aft thrust reverser.)

(b) Check aft thrust reverser follow-up installations.

1) Check cables and pulleys for excessive wear.

2) Check rigging and tension. (See 78-6-21, "Adjustment/Test Aft Thrust Reverser.)

(11) Visually inspect ring and deflector assembly for cracks. (See figure 206.)

(a) Cracks in the longitudinal braces and stiffeners for the hinge support fitting up to 1.0 inch in length are considered to be tolerable before repair.

(b) Cracks in upper and lower deflector skins adjacent to the weld between the hinge support casting and deflector skin may be allowed to grow to 4.50 inches and then stop drilled 1/8 inch diameter and unit allowed to continue in service until overhaul. If crack progresses after stop drill, it must be repaired.

(c) Cracks in the basic hinge support casting, originating at weld and progressing towards centerline of hinge, must be repaired immediately.

(d) Cracks up to 3/4 inch in length resulting from failed spotwelds between the stiffeners and the deflector skins are allowable before repair is necessary.

(12) Examine aft thrust reverser translating sleeve.

(a) Check for missing or loose rivets. If the number of missing rivets exceeds two rivets in adjoining holes or 4 rivets in 15 inches in any one rivet row repair according to instructions in Chapter 54, "Structural Repair Manual."

(b) Check for skin cracks. Cracks up to 4 inches are tolerable providing the crack does not go through more than two fastener holes.

(c) Check for broken or cracked frames. These must be repaired immediately. Refer to Chapter 54, "Structural Repair Manual."

4. Approved Repairs Aft Thrust Reverser

A. General

(1) Maintenance and repair of the thrust reverser consists largely of welding. All components are of stainless steel (AISI 321), except vane assemblies which are of Hastelloy-X. Welding should by by the inert-gas tungsten-arc process (Heliarc).

(2) Parts must not be pickled before welding because the acids used would become entrapped in areas where it would be impossible to adequately neutralize the solution. Before welding, parts should be degreased by any of the liquid or vapor methods employed for other aircraft parts. Parts may be cleaned by Vapor-Blast or Dry-Hone process. A 25-30% nitric acid solution may be used.

B. Equipment and Materials

(1) Inert tungsten arc welding equipment.

(2) Bare filler wire - Hastelloy W, 19-9WX or AISI 347

(3) Spreader Bar

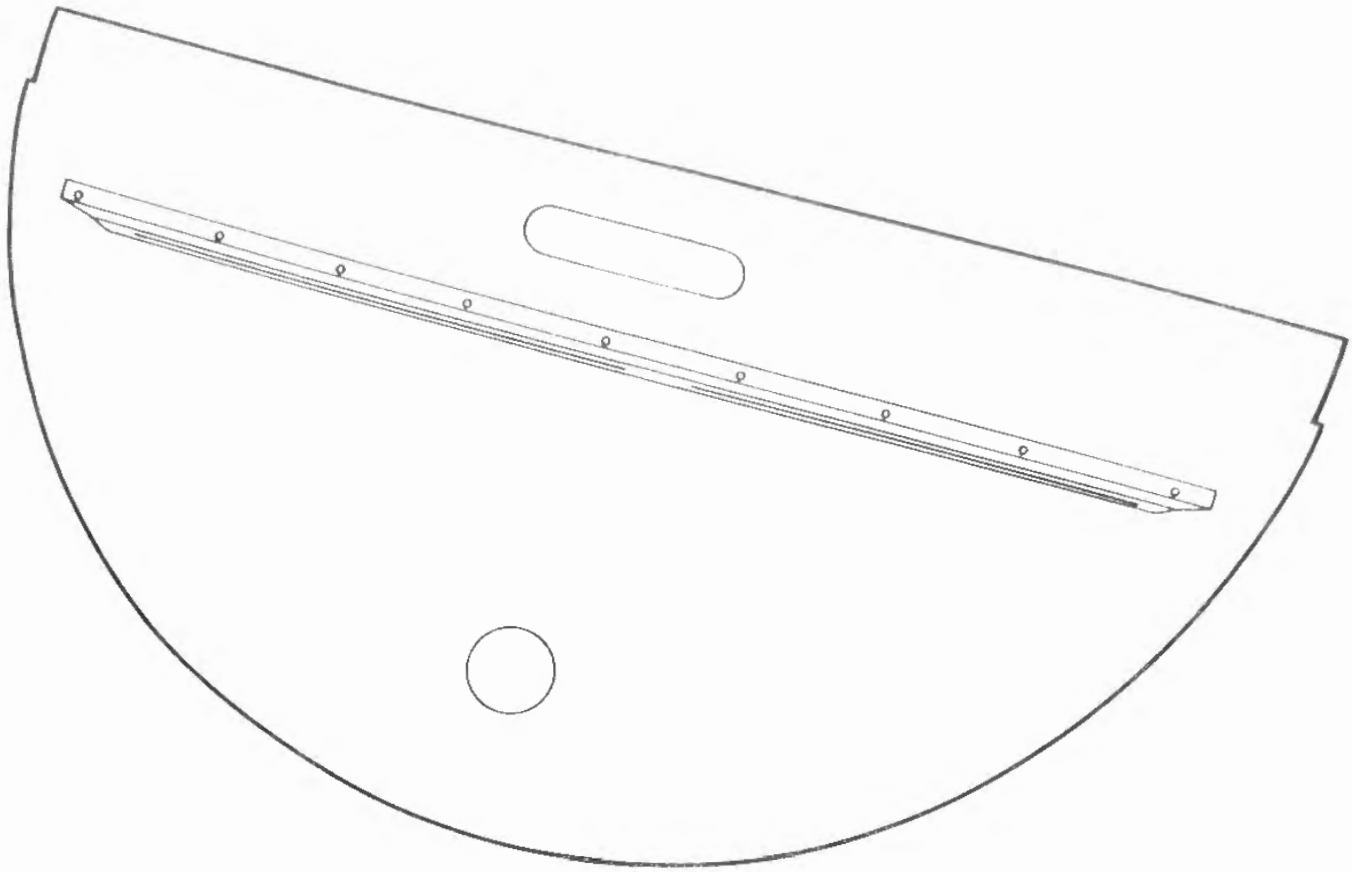
(4) Clamshell door contour template.

C. Repair Clamshell Door Assemblies

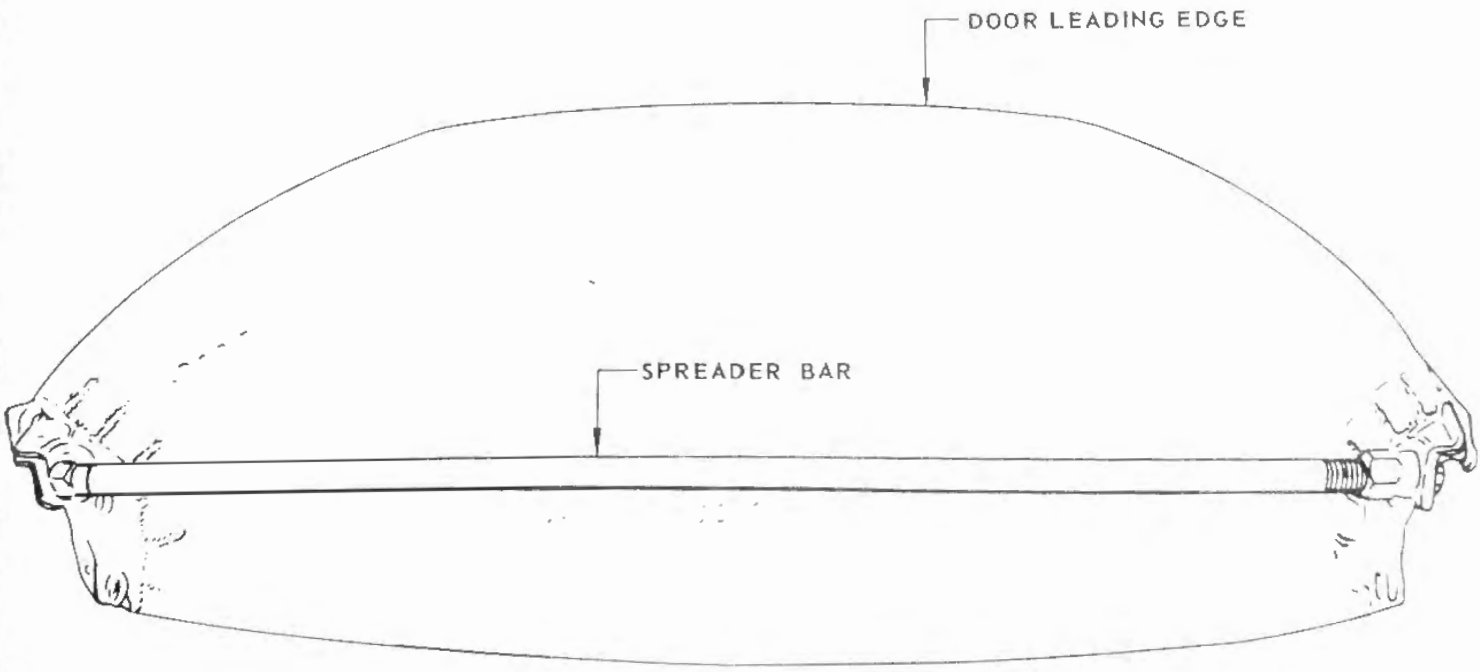
(1) If the leading edges of the clamshell doors do not properly mate with the forward seal the door is probably out of contour and should be reworked.

(a) In some cases, the leading edges of the doors can be reworked on the engine. Access to the doors can be gained by removing the vane segment assemblies. The doors are easily disconnected from their actuating arms so that they can be moved by hand.

(b) If the thrust reverser is off the engine and the doors are out of contour, remove them from the rest of the thrust reverser. With the doors removed, the template shown in figure 208 may be used to establish the correct contour. In conjunction with the template, a spreader bar as shown in figure 209 is recommended. The spreader bar aids in establishing the correct spacing between door fittings and holds the door during rework. Figure 210 shows the recommended use of the template and



Clamshell Door Contour Template
Figure 208



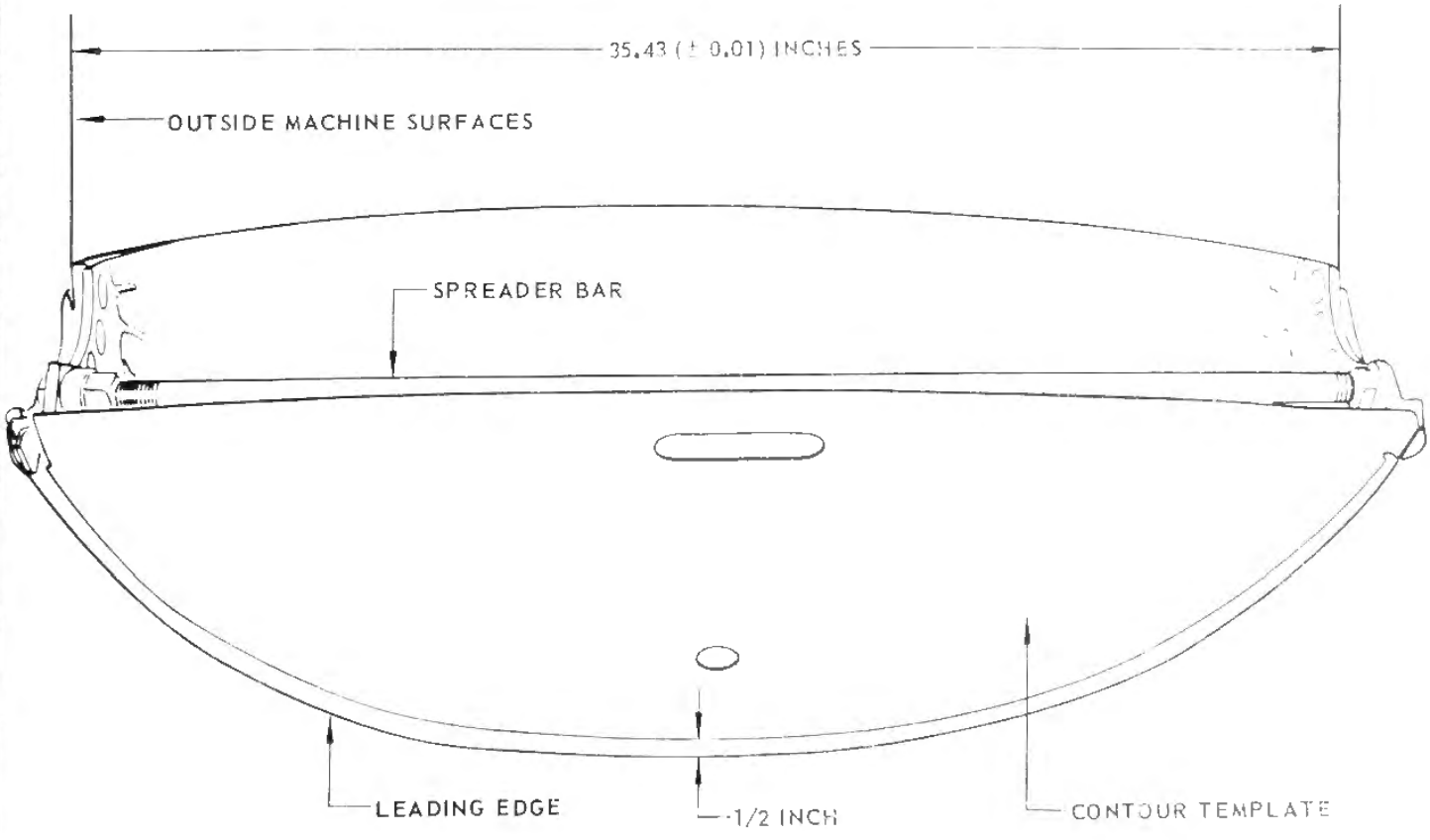
Spreader Bar Application
Figure 209

spreader bar for checking door contour. The spreader bar can be made easily from material normally found in a machine shop. The correct distance between machined faces of the hub fittings is 35.43 (± .01) inches.

(c) Keep seamweld cracks on the inner skin of the door under surveillance. The need for repair depends on the location of cracks and their rate of increase. (See figure 204.) Repair cracks near hub fitting by welding, especially if they form a continuous line of defects.

(d) When cracks exceed the limits shown for the hinge area (figure 203) they should be repaired by welding as soon as the airplane reaches a base having the necessary facilities.

(e) Replace missing seal leaves on aft door seal if seal leaves are missing from both inner and outer layer. Sealing is not appreciably affected if leaves from only one layer are missing.



Spreader Bar and Template Installed for Contour Rework
Figure 210

D. Repair Forward Seal Assembly

(1) A few isolated cracks at the radius of the seal mounting flange are not serious. If a crack is continuous for 6.00 inches or more repair at overhaul. If the seal has been separated from the mounting flange, repair as soon as possible.

E. Repair Ring and Deflector Assembly (Figure 206)

(1) Repair cracks in ring and deflector assembly by inert tungsten arc welding (Heliarc). Use Hastelloy "W" or AISI 347 bare filler wire only. See figure 206 for crack limitations and repair data.

F. Repair Cascade Vane Assemblies

(1) Repair cracks in vane segment assemblies by welding. Use Hastelloy "W" filler wire only. Typical repairs are shown in figure 207.

G. Replace Thrust Reverser Forward Seal Assembly

(1) Replacement of the thrust reverser forward seal assembly is accomplished by removing the thrust reverser. The forward seal is then separated from the thrust reverser by removing 4 countersunk bolts holding the forward seal support ring to the thrust reverser ring and deflector assembly.

H. Replace Thrust Reverser Aft Seal Assemblies

(1) The aft seals are installed on the aft edges of the clamshell doors and replacement is accomplished by removing the doors. See "Removal/Installation Clamshell Doors."

I. Replace Thrust Reverser Hub Seals

(1) The hub seals are installed on the clamshell doors between the doors and door hinges. Replacement is accomplished by removing the doors. See "Removal/Installation Clamshell Doors."

AFT THRUST REVERSER SLEEVE - MAINTENANCE PRACTICES

1. Removal/Installation Aft Thrust Reverser Sleeve

A. General

(1) The aft thrust reverser sleeve may be removed from the engine without removing the thrust reverser assembly and tailpipe assembly.

B. Equipment and Material

(1) Air pressure source - 0 to 60 psig.

(2) Anti-seize compound, Ease-Off 990 (Texacone Company, Dallas 8, Texas) or equivalent.

C. Remove Aft Thrust Reverser Sleeve

(1) Place thrust reverser in reverse thrust position. (See 78-5-61, "Removal/Installation Aft Thrust Reverser.")

(2) Disconnect hinge drive mechanism drag links (view 1, figure 201) from aft thrust reverser sleeve assembly.

(3) Disconnect lower actuator rods (view 2) from lower actuators truck assembly by removing cotter pin, bolt, nut, and two bushings (2 places).

(4) Disconnect sleeve lower track support link (view 3) from sleeve track by removing nut, bolt, and bushing.

(5) On airplanes having sleeve forward ring upper support fitting as shown in view 4, figure 201, remove aft thrust reverser upper actuators assembly (1, view 4, figure 201) to permit removal of sleeve.

(a) Manually position thrust reverser in forward thrust position.

(b) Remove aft thrust reverser sleeve access panels L3708 and R3708 in strut fairing area of sleeve.

(c) Remove bolt (3), nut, and bushing (2 places) attaching actuator assembly to tailpipe.

(d) Disconnect actuator piston rods from sleeve connection by removing bolt (2), 2 bushings, washer, nut, and cotter pin in two places.

(e) Manually move sleeve aft to gain access to upper actuator truck attachment bolts (5).

(f) Remove 3 bolts, washers, serrated splice plate and shims attaching truck to forward ring.

(g) Remove bolt (4), nut, and two bushings attaching upper actuators assembly to upper actuator support link and remove assembly (1).

(6) On airplanes having sleeve forward ring upper support fitting as shown in view 5, figure 201, proceed as follows to permit removal of sleeve.

(a) Slide sleeve forward but do not engage sleeve locks.

(b) Disconnect sleeve support fitting bolts (5), nuts (6) and shims if used.

(c) Remove aft thrust reverser sleeve access panels L3708 and R3708 in strut fairing area of sleeve.

(d) Disconnect actuator piston rods from sleeve connection by removing bolt (2), two bushings, washer, nut and cotter pin in two places.

(7) Disconnect roller truck assemblies (detail A) from tailpipe sleeve track connections (4 places).

(a) Gain access to truck assemblies through five aft thrust reverser sleeve access panels (L3708, R3708, L3710, R3710 and 3711) located half way back on sleeve at left and right hand horizontal centerline, lower vertical centerline, and on right and left hand strut fairing portion of sleeve. See Chapter 12, "Access Doors and Panels."

(b) Remove sleeve support shaft, spacer, 3 pins with cotter pins, 2 washers, 2 bushings, and 2 nuts attaching sleeve to truck assembly at support link assembly.

(8) With two men, one on each side of the sleeve assembly, slide sleeve aft over tailpipe and away from engine.

D. Install Aft Thrust Reverser Sleeve

(1) Coat threaded surfaces of all bolts or shafts with anti-seize compound prior to installation.

(1A) Position 4 roller truck assemblies (detail A, figure 201) on tailcone near forward end of tracks.

(2) With two men, one on each side of the thrust reverser sleeve, position sleeve forward over tailpipe and thrust reverser assembly.

(a) Position rollers of lower actuators truck assembly in grooves at aft end of lower sleeve track prior to moving the sleeve assembly forward.

(b) Move sleeve forward until sleeve support link assemblies (detail A) on sleeve align with roller truck assemblies on tailpipe.

(3) Attach sleeve support link assemblies to roller truck assemblies (4 places).

(a) Gain access to support links and truck assemblies through five aft thrust reverser sleeve access panels (L3708, R3708, L3710, R3710 and 3711) located half way back on sleeve at left and right hand horizontal centerline, lower vertical centerline, and left and right hand sides in upper strut fairing area of sleeve.

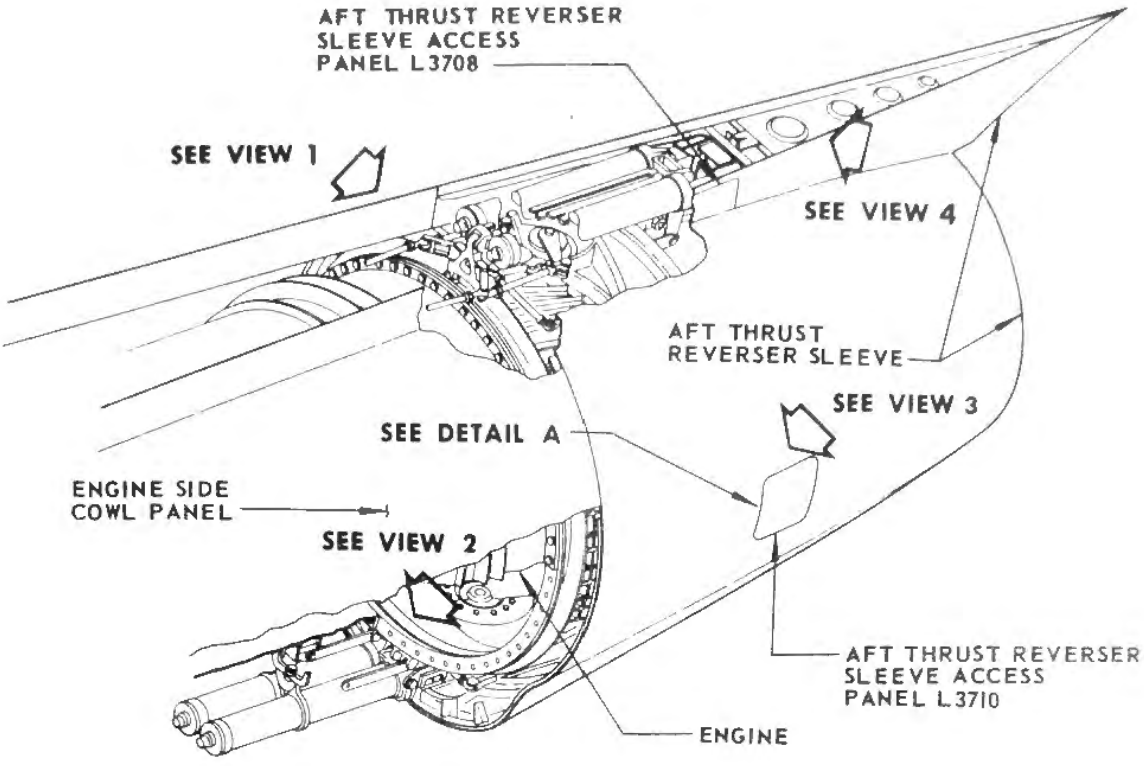
(b) Align truck with support link assembly and attach with support shaft, spacer, 3 pins with cotter pins, 2 bushings, 2 washers, and 2 nuts (4 places).

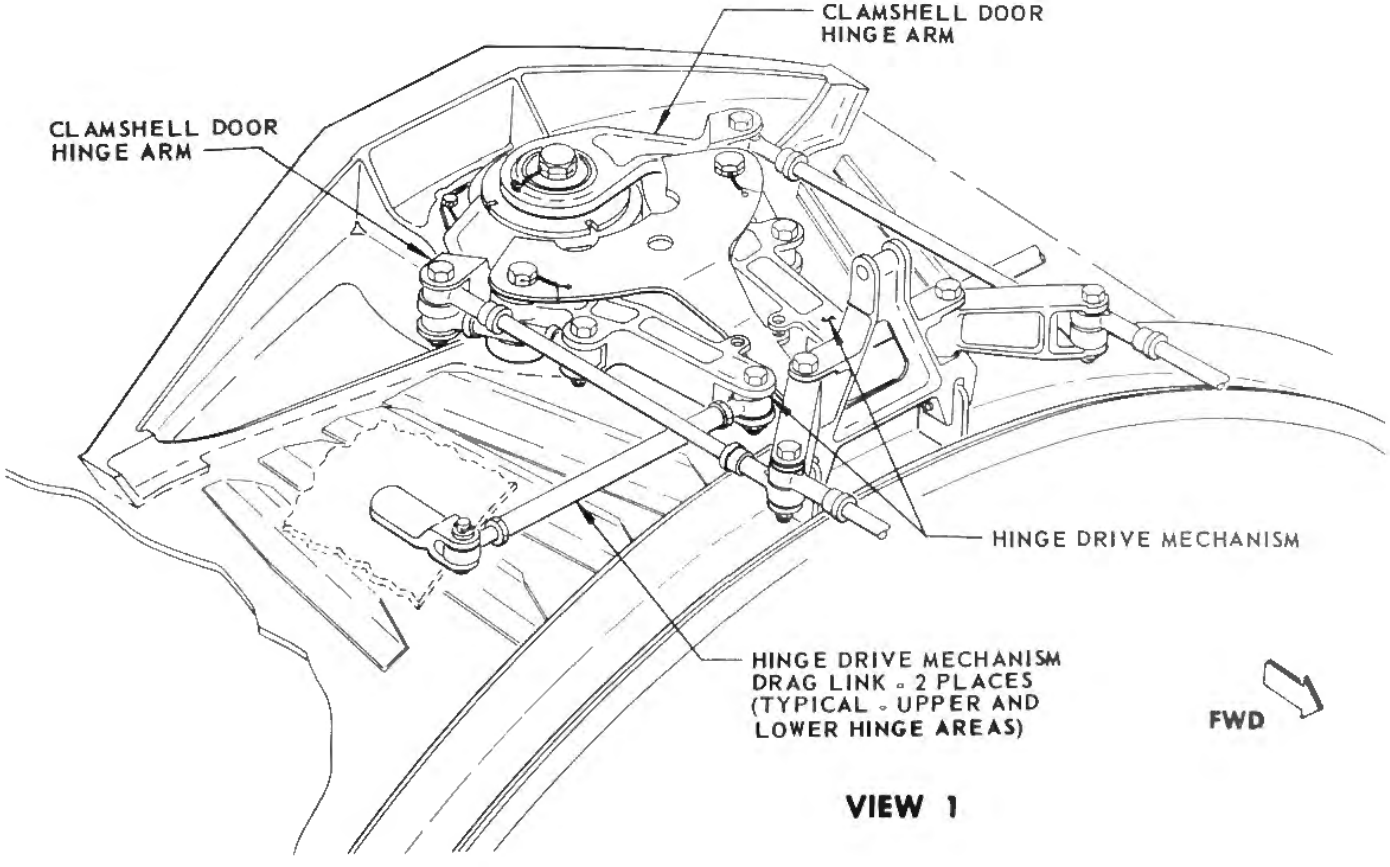
(4) On airplanes having sleeve forward ring upper support fitting as shown in view 4, figure 201, install aft thrust reverser upper actuators assembly (See view 4, figure 201.)

(a) Slide sleeve forward so that sleeve forward ring is forward of tailpipe mounting flange.

(b) Position actuators from forward end of sleeve. Align upper actuator truck assembly with mounting surface on sleeve forward ring.

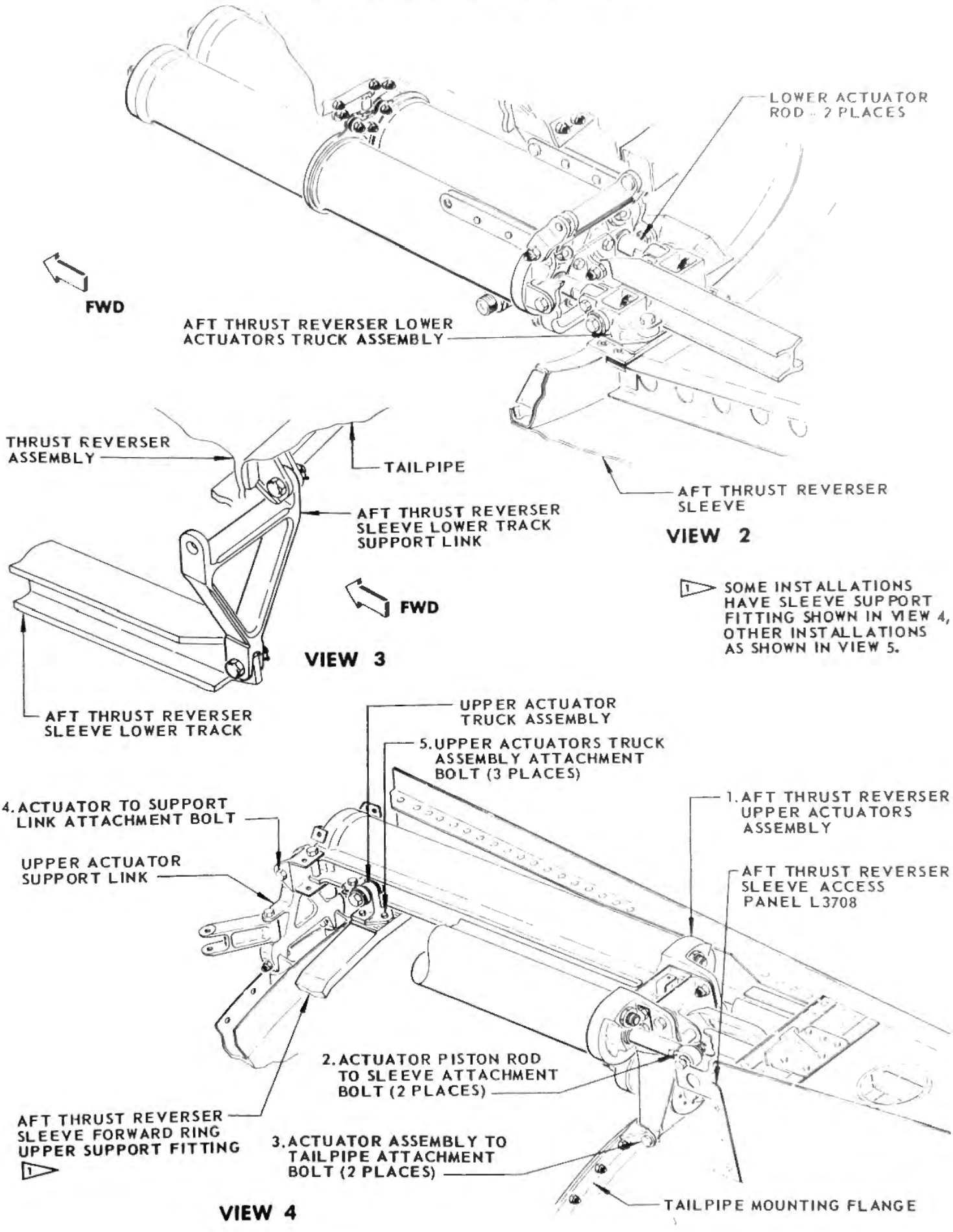
(c) Attach sleeve forward ring to upper actuator truck with 3 bolts (5) and washers, serrated splice plate, and shims. Position splice plate and shims between truck and upper surface of forward ring. Install bolts from bottom side of ring.

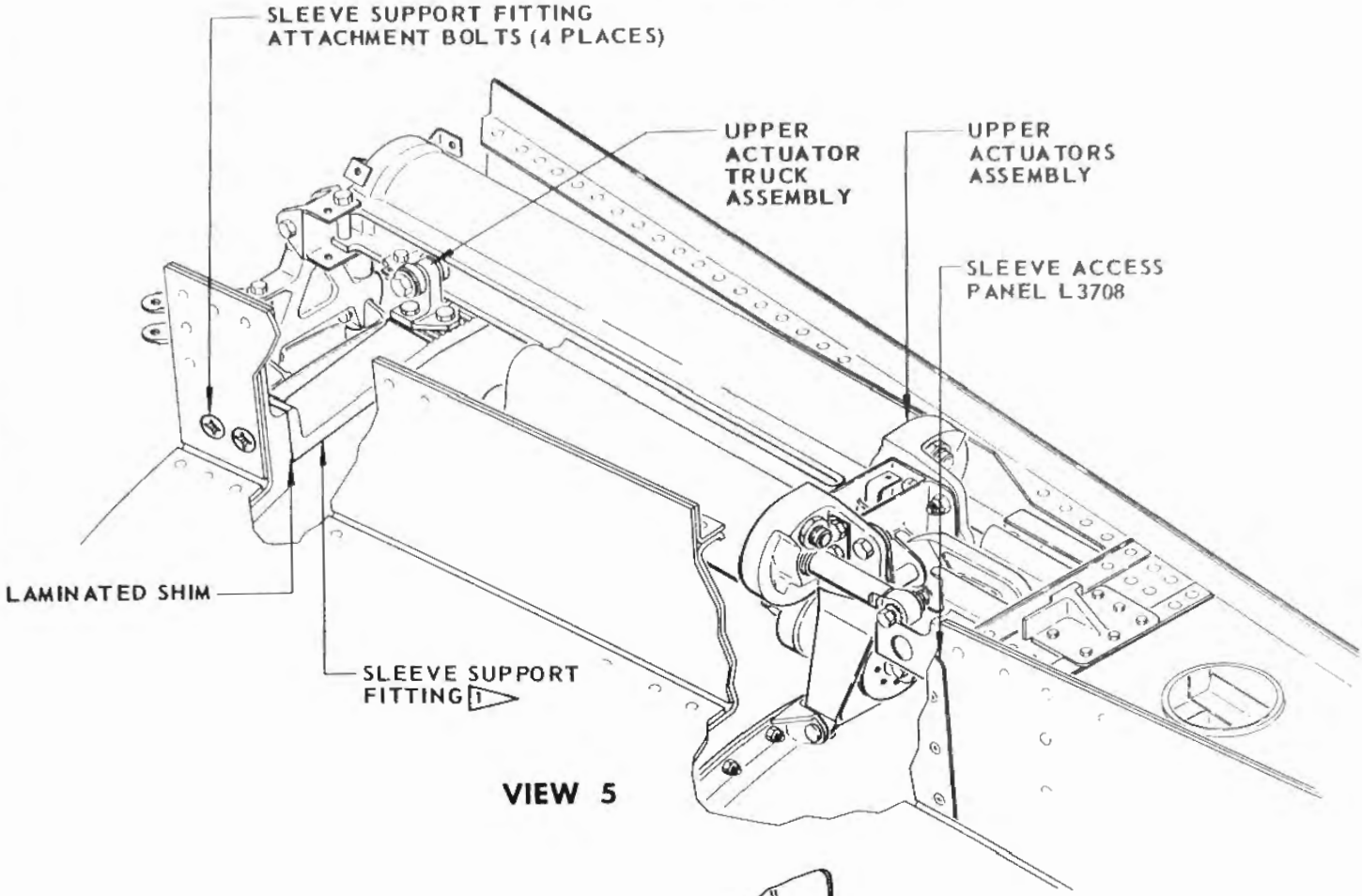




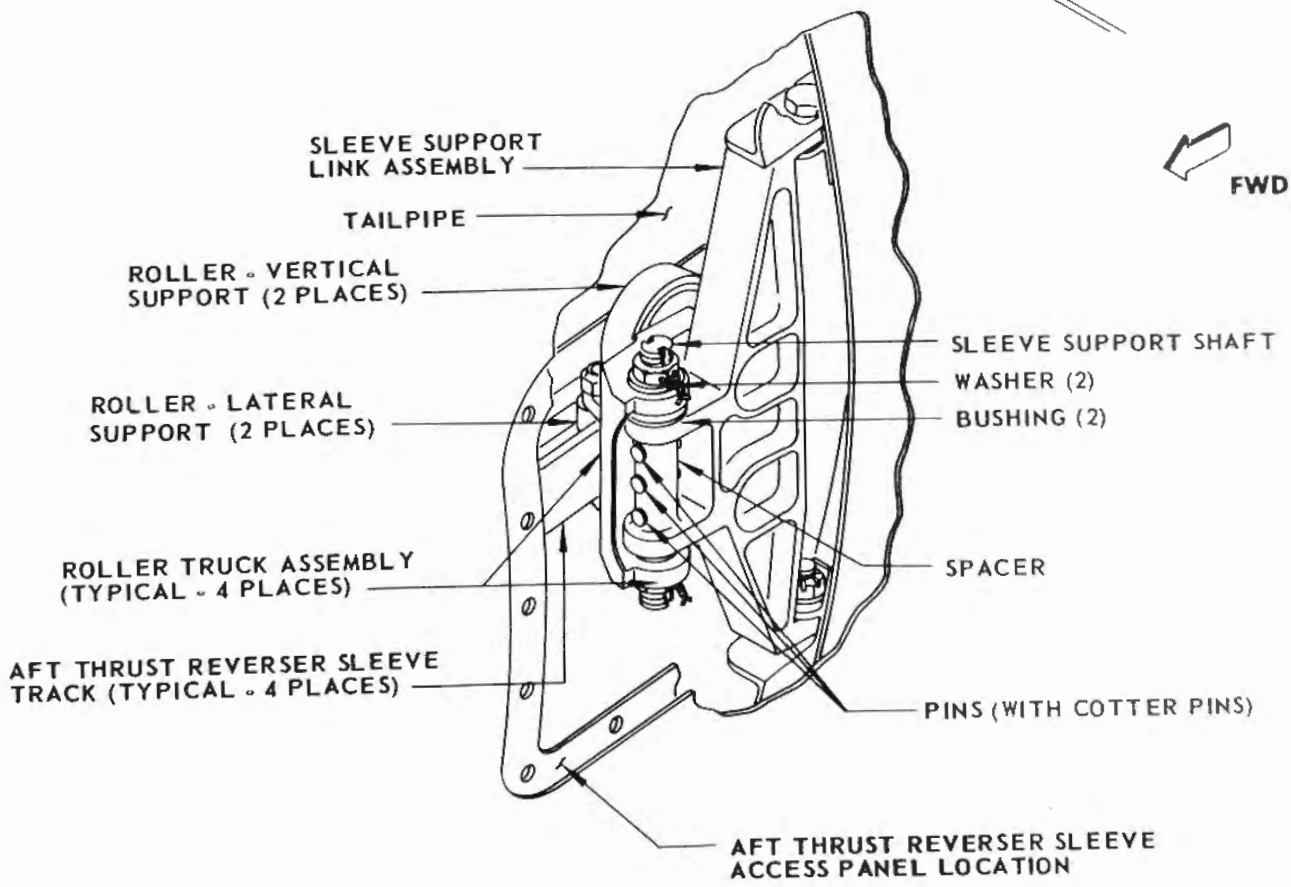
VIEW 1

Aft Thrust Reverser Sleeve Installation
Figure 201 (Sheet 1 of 3)


LOWER ACTUATOR ROD - 2 PLACES
FWD
AFT THRUST REVERSER LOWER ACTUATORS TRUCK ASSEMBLY
AFT THRUST REVERSER SLEEVE
VIEW 2
THRUST REVERSER ASSEMBLY
TAILPIPE
AFT THRUST REVERSER SLEEVE LOWER TRACK SUPPORT LINK
FWD
VIEW 3
AFT THRUST REVERSER SLEEVE LOWER TRACK
1 SOME INSTALLATIONS HAVE SLEEVE SUPPORT FITTING SHOWN IN VIEW 4, OTHER INSTALLATIONS AS SHOWN IN VIEW 5.
UPPER ACTUATOR TRUCK ASSEMBLY
5. UPPER ACTUATORS TRUCK ASSEMBLY ATTACHMENT BOLT (3 PLACES)
4. ACTUATOR TO SUPPORT LINK ATTACHMENT BOLT
UPPER ACTUATOR SUPPORT LINK
1. AFT THRUST REVERSER UPPER ACTUATORS ASSEMBLY
AFT THRUST REVERSER SLEEVE ACCESS PANEL L3708
2. ACTUATOR PISTON ROD TO SLEEVE ATTACHMENT BOLT (2 PLACES)
AFT THRUST REVERSER SLEEVE FORWARD RING UPPER SUPPORT FITTING
1
3. ACTUATOR ASSEMBLY TO TAILPIPE ATTACHMENT BOLT (2 PLACES)
TAILPIPE MOUNTING FLANGE
VIEW 4



VIEW 5



DETAIL A

Aft Thrust Reverser Sleeve Installation
Figure 201 (Sheet 3 of 3)

(d) Attach actuators to tailpipe with bolt (3), nut, and bushing (2 places).

(e) Attach actuators to upper actuator support link with bolt (4), nut, and two bushings.

(5) On airplanes having sleeve forward ring upper support fitting as shown in view 5, figure 201, connect thrust reverser sleeve to support fitting.

(a) Manually position sleeve to forward thrust position.

(b) Align sleeve support fitting attached to upper truck assembly with attachment holes on forward end of aft thrust reverser sleeve and install sleeve fitting attachment bolt (5) and nut (6) four places. Install shims as necessary between sleeve and support fitting to maintain alignment of sleeve with strut and side cowl panels per 78-5-61, "Rig Aft Thrust Reverser." Use maximum of 2 shims per side and remove .002 inch laminations as required.

(6) Attach lower track support link assembly (view 3) to track.

(7) Install aft thrust reverser upper actuators assembly piston rods to sleeve using bolt (2, view 4) in two places.

(a) With sleeve in reverse thrust position, gain access to actuator rods and sleeve connection through access panels L3708 and R3708.

(b) Position eccentric bushing in rod end.

(c) Position plain bushing in eccentric bushing.

(d) Attach rod end with bolt (2) nut, washer, and cotter pin to sleeve connection.

(8) Install aft thrust reverser lower actuators assembly piston rods (view 2) to sleeve.

(a) Position rod end between truck connection mounting flanges and attach with bolt, bushings, cotter pin and nut (2 places).

(9) Attach hinge drive mechanism drag links (view 1) to sleeve.

(a) Position drag link rod ends at attachment flanges on sleeve and attach with pin, washer, and cotter pin (4 places).

(10) Adjust entire installation. See 78-5-61, "Adjustment/Test Aft Thrust Reverser."

TAILPIPE - MAINTENANCE PRACTICES

1. Removal/Installation Tailpipe

A. General

(1) The tailpipe may be removed by removing the aft thrust reverser sleeve and then removing the tailpipe from the aft thrust reverser assembly.

B. Equipment and Materials

(1) Antiseize compound, Ease-Off 990 (Texacone Company, Dallas 8, Texas) or equivalent.

C. Remove Tailpipe

(1) Remove aft thrust reverser sleeve. (See 78-5-71, Remove Aft Thrust Reverser Sleeve.)

(2) Remove bolts (60 places) at tailpipe mounting ring, holding tailpipe to aft thrust reverser assembly. Remove upper bolts last.

D. Install Tailpipe

(1) Coat threaded surface and shank to head of all bolts with antiseize compound prior to installation.

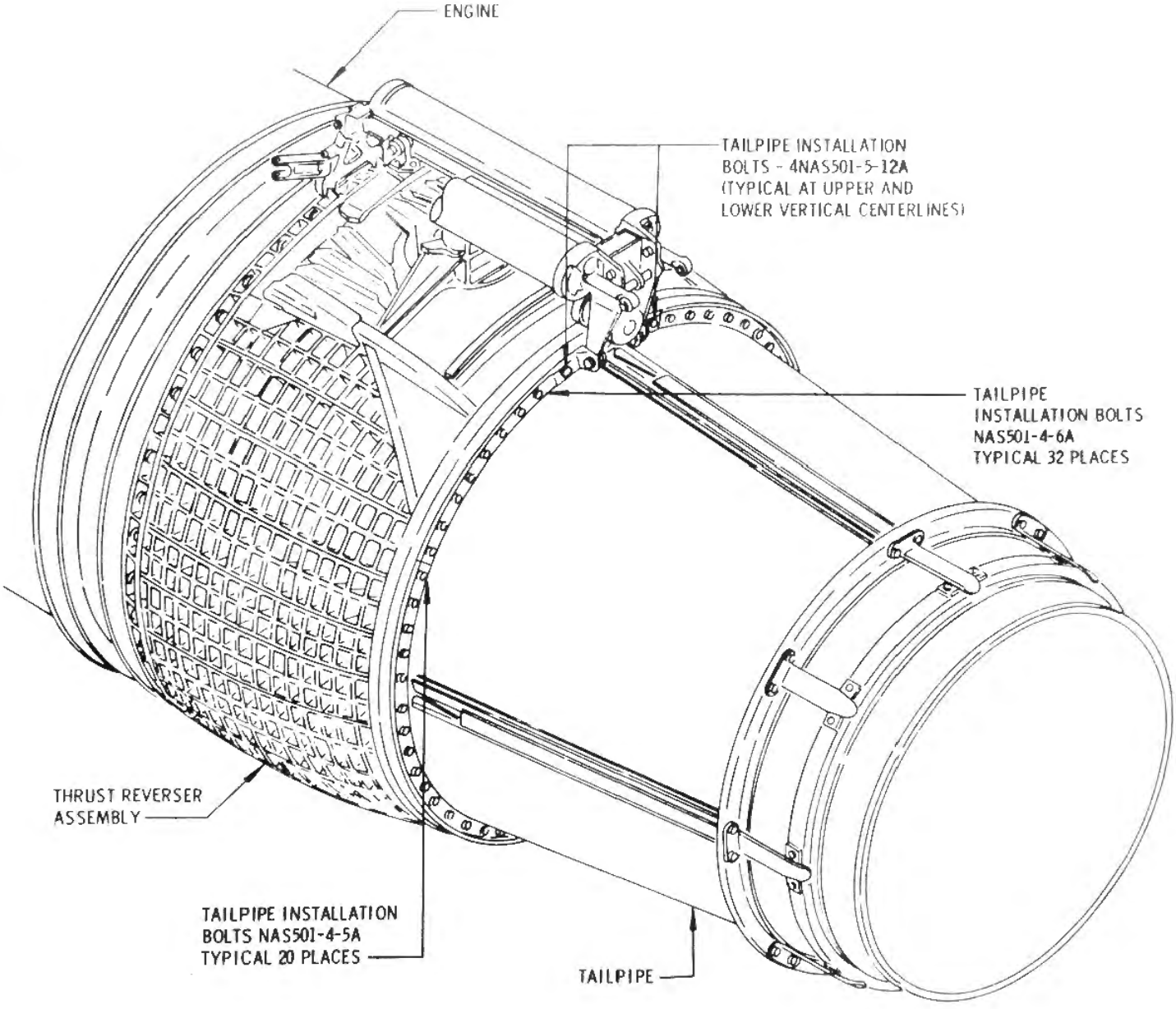
(2) Position tailpipe on thrust reverser assembly aft mounting ring and install with 60 bolts. (See figure 201.)

(a) Install two NAS501-5-12A bolts on each side (total four) at upper vertical centerline and (four) at lower vertical centerline.

(b) Install thirty-two NAS501-4-6A bolts.

(c) Install twenty NAS501-4-5A bolts.

(3) Install aft thrust reverser sleeve. (See 78-5-7, Install Aft Thrust Reverser Sleeve.)


ENGINE
TAILPIPE INSTALLATION BOLTS - 4NAS501-5-12A (TYPICAL AT UPPER AND LOWER VERTICAL CENTERLINES)
TAILPIPE INSTALLATION BOLTS NAS501-4-6A TYPICAL 32 PLACES
THRUST REVERSER ASSEMBLY
TAILPIPE INSTALLATION BOLTS NAS501-4-5A TYPICAL 20 PLACES
TAILPIPE

CASCADE VANE ASSEMBLIES - MAINTENANCE PRACTICES

1. Removal/Installation Cascade Vane Assemblies

A. General

(1) Cascade vane assemblies may be removed from the aft thrust reverser while it is installed on the airplane provided the thrust reverser is in the reverse thrust position.

B. Equipment and Materials

(1) Antiseize compound - Ease-Off 990 (Texacone Company, Dallas 8, Texas) or equivalent.

(2) Air pressure souce - 0 to 60 psig

C. Remove Cascade Vane Assemblies

(1) Place thrust reverser in reverse thrust position.

(a) Connect air pressure source to ground service connection and regulate to 30 psig.

(b) Move applicable reverse thrust lever in control cab aft to interlock position. Check that thrust reverser has actuated to reverse thrust position.

(c) Disconnect ground air supply.

WARNING: WITH THRUST REVERSER IN REVERSE THRUST POSITION, GROUND AIR SOURCE MUST BE DISCONNECTED BEFORE WORKING ON THRUST REVERSER TO PRECLUDE INJURY TO PERSONNEL.

(2) Remove bolts holding vane assemblies to thrust reverser forward support ring. (See figure 202.) Tag removed vane assemblies with location numbers as shown in figure 201 to facilitate identification of vane assembly with respect to installation position. Any similar scheme for identifying vane assemblies with respect to installation positions may be used.

NOTE: Vane assemblies at locations R4, R5, R6, and R7 and L4, L5, L6, and L7 on all engines (figure 201 for location) have clamshell door stops mounted through forward end of the vane assembly. These stops need not be removed when removing vane assemblies.

(3) Remove vane assemblies by lifting out and forward from thrust reverser.

D. Install Cascade Vane Assemblies

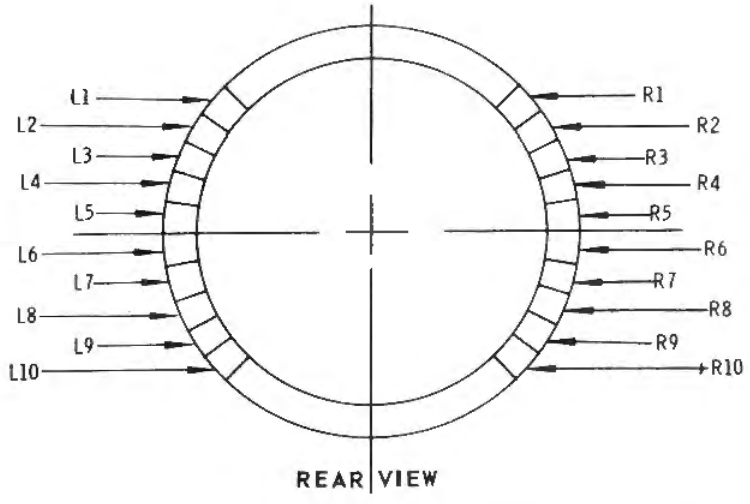
(1) Put thrust reverser in reverse thrust position.

(a) Connect external air source and regulate to 30 psig.

(b) Move applicable reverse thrust lever in control cab to interlock position. Check that the thrust reverser has moved to the reverse thrust position.

(c) Disconnect external air source.

WARNING: WITH THRUST REVERSER IN REVERSE THRUST POSITION, GROUND AIR SOURCE MUST BE DISCONNECTED BEFORE WORKING ON THRUST REVERSER TO PRECLUDE INJURY TO PERSONNEL.



CASCADE VANE ASSEMBLY LOCATIONS - TYPICAL

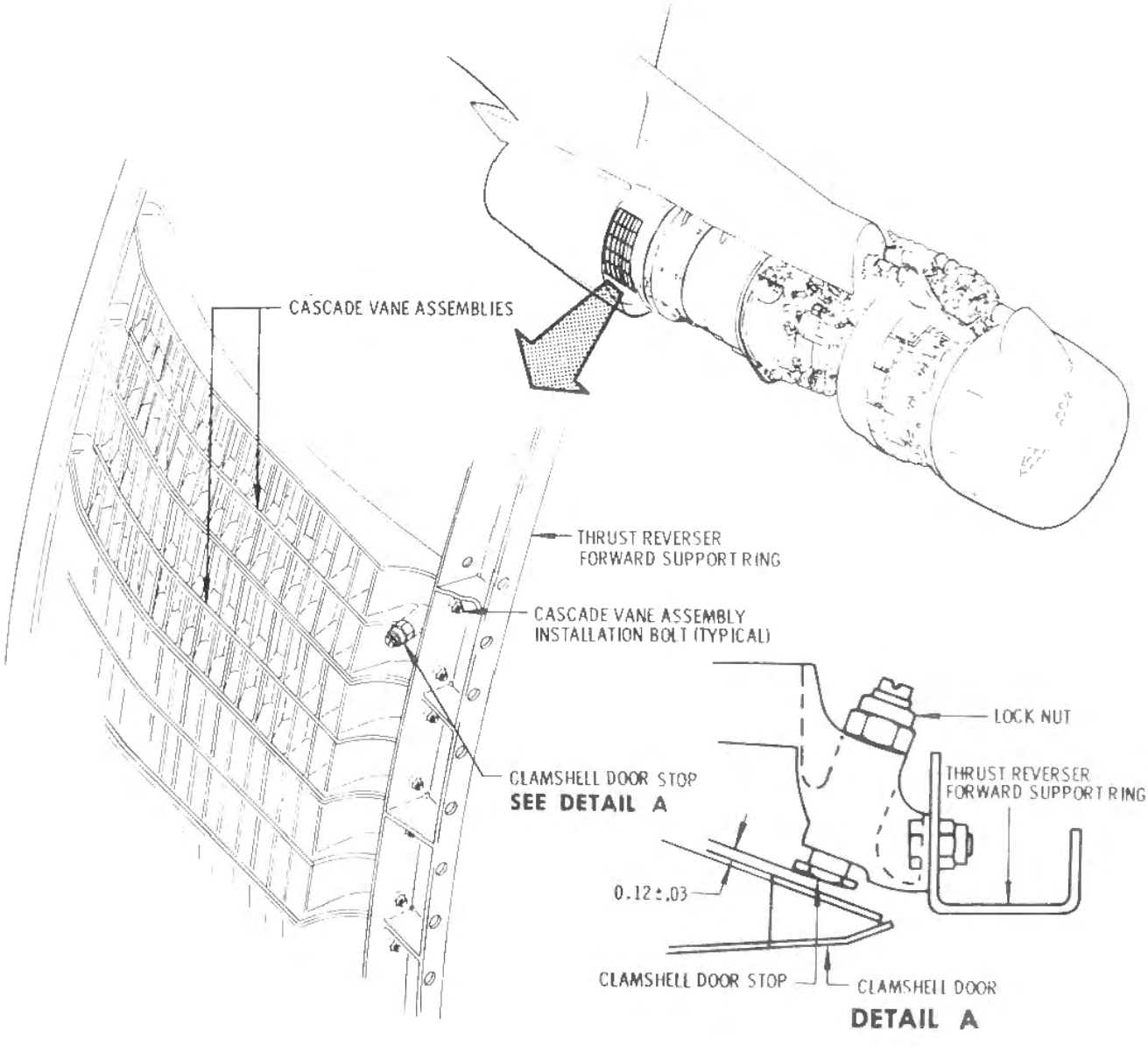
WHEN REMOVING VANE ASSEMBLIES, TAG WITH LOCATION NUMBERS AS SHOWN ABOVE, OR USE ANY EQUIVALENT SYSTEM FOR IDENTIFYING POSITION OF VANE ASSEMBLY ON REVERSER

Cascade Vane Assembly Location Diagram
Figure 201

(2) Coat threaded surface and shank to head of all bolts with anti-seize compound prior to installation.

(3) Position cascade vane assembly or assemblies on thrust reverser per figure 201 and attach with bolts to thrust reverser forward support ring. (See figure 202.)

(4) Check and adjust clearance between clamshell door and clamshell door stops to 0.12 (± 0.03) inch. See figure 202 for correct positioning of stops. Vane assemblies having clamshell door stops are located in positions R4 through R7 and L4 through L7 as called out in figure 201.



CLAMSHELL DOOR - MAINTENANCE PRACTICES

1. Removal/Installation Clamshell Door

A. Equipment and Materials

(1) Air pressure source - 0 to 200 psig capacity.

(2) Antiseize compound - Ease-Off 990 (Texacone Company, Dallas 8, Texas) or equivalent

(3) Clamshell door spreader bar or retracting tool - F70061 or equivalent.

B. Remove Clamshell Door

(1) Remove aft thrust reverser sleeve. See 78-5-71, "Remove Aft Thrust Reverser Sleeve."

(2) Remove tailpipe. See 78-5-81, "Remove Tailpipe."

(3) Disconnect aft thrust reverser follow-up rods at aft follow-up idler link connections. See figure 201, 78-5-61.

(4) Manually rotate clamshell doors to forward thrust position.

(5) Remove bolts holding clamshell door to hinge face.

(6) Install clamshell retracting rod assembly on clamshell door.

(a) Remove rod ends from rod assembly.

(b) Thread rod ends into two tapped holes on interfaces of clamshell door attachment fittings.

(c) Position rod assembly and secure to rod ends with flat head pins.

(7) Compress door to overall dimension of 35.06 (+0.00/-0.10) inches with rod assembly.

(8) Remove door through rear of thrust reverser.

CAUTION: EXERCISE CARE WHEN REMOVING DOOR TO PREVENT DAMAGE TO HUB SEAL.

C. Install Clamshell Door

(1) Install clamshell retracting rod assembly on clamshell door.

(a) Remove rod ends from rod assembly.

(b) Thread rod ends into two tapped holes on interfaces of clamshell door attachment fittings.

(c) Position rod assembly and secure to rod ends with flat head pins.

(2) Compress clamshell door to overall dimension of 35.06 (+0.00/-0.10) inches with rod assembly.

(3) Position door in thrust reverser and start several bolts on each end of door.

(4) Remove rod assembly.

(a) Expand rod assembly and remove from rod ends.

(b) Remove rod ends from clamshell door attachment fittings.

(5) Coat thread surfaces and complete shank of bolts with thread lubricant.

(6) Install remaining bolts through door fitting and hinge face. Torque bolts 95 to 110 pound-inches.

NOTE: 0.032 inch thick washers may be used if and as required to maintain minimum clearance of 0.04 inches between clamshell door installation bolts and hinge•support fitting.

(7) Install tailpipe. See 78-5-81, "Install Tailpipe."

(8) Replace aft thrust reverser sleeve. See 78-5-71, "Install Aft Thrust Reverser Sleeve."

EXHAUST PLUG - MAINTENANCE PRACTICES

1. Removal/Installation Exhaust Plug

A. General

(1) The exhaust plug may be removed by removing the cascade vane assemblies on either side of the aft thrust reverser with the aft thrust reverser sleeve and the clamshell doors in the reverse thrust position.

B. Special Materials

(1) Antiseize compound, Ease-Off 990 (Texacone Company, Dallas 8, Texas) or equivalent

C. Remove Exhaust Plug

(1) Open engine side cowl panels.

(2) Manually move aft thrust reverser sleeve aft to reverse thrust position.

(3) Remove cascade vane assemblies. See 78-5-91, "Remove Cascade Vane Assemblies."

(4) Remove bolts in exhaust plug support ring holding exhaust plug to engine plug support and remove.

D. Install Exhaust Plug

(1) Install exhaust plug by installing bolts holding exhaust plug to engine plug support. Coat threaded surfaces and complete shank of bolt with antiseize compound.

(2) Install cascade vane assemblies. See 78-5-91, "Install Cascade Vane Assemblies."

(3) Return aft thrust reverser to forward thrust position.

(a) Connect ground air supply to ground service connection. Gain access to ground service connection through access panels 1705, 1737 or 3716 on strut. See Access Doors and Panels, 12-2-0.

(b) With applicable reverse thrust lever in control cab and "IDLE" position, regulate ground air supply to 30 psig to bring thrust reverser to forward thrust position.

(4) Close side cowl panels.

THRUST REVERSER CONTROL SYSTEM - DESCRIPTION AND OPERATION

1. General

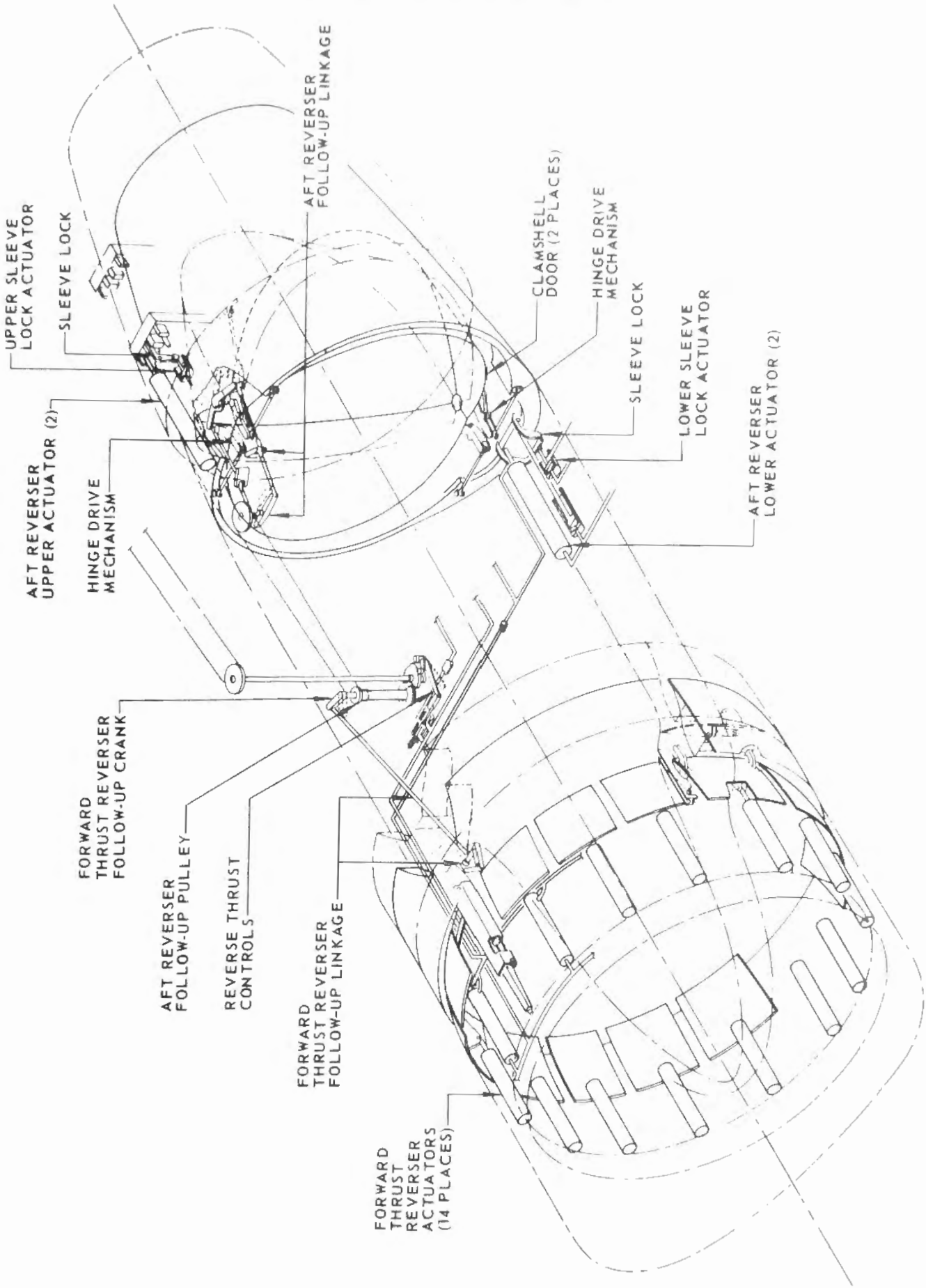
A. The thrust reverser control system directs pneumatic pressure to the actuators of the forward and aft thrust reversers which position the flow reversing components for the desired forward or reverse thrust operations. The system consists of the reverse thrust controls mounted on the thrust control shaft and on the engine controls strut bracket, forward thrust reverser follow-up linkage, aft thrust reverser follow-up linkage, hinge drive mechanisms, forward thrust reverser actuators, aft reverser actuator assemblies, and miscellaneous control system components. (See figure 1.)

B. A lock-out feature in the system prevents application of full forward or reverse thrust until the flow reversing components of the forward and aft thrust reversers have nearly reached their full travel position for forward or reverse thrust. A forward thrust reverser locking cam and an aft thrust reverser locking cam lock the thrust control shaft in a partial thrust position until follow-up linkages connecting the cams to the forward thrust reverser cowl ring and aft reverser sleeve reposition the cams to allow full forward or reverse thrust operation. On airplanes VH-EBL and on, an override provision on the forward thrust reverser interlock allows application of increased thrust by manual override of a spring loaded interlock position if additional thrust is required to move the forward thrust reverser back to the cruise position.

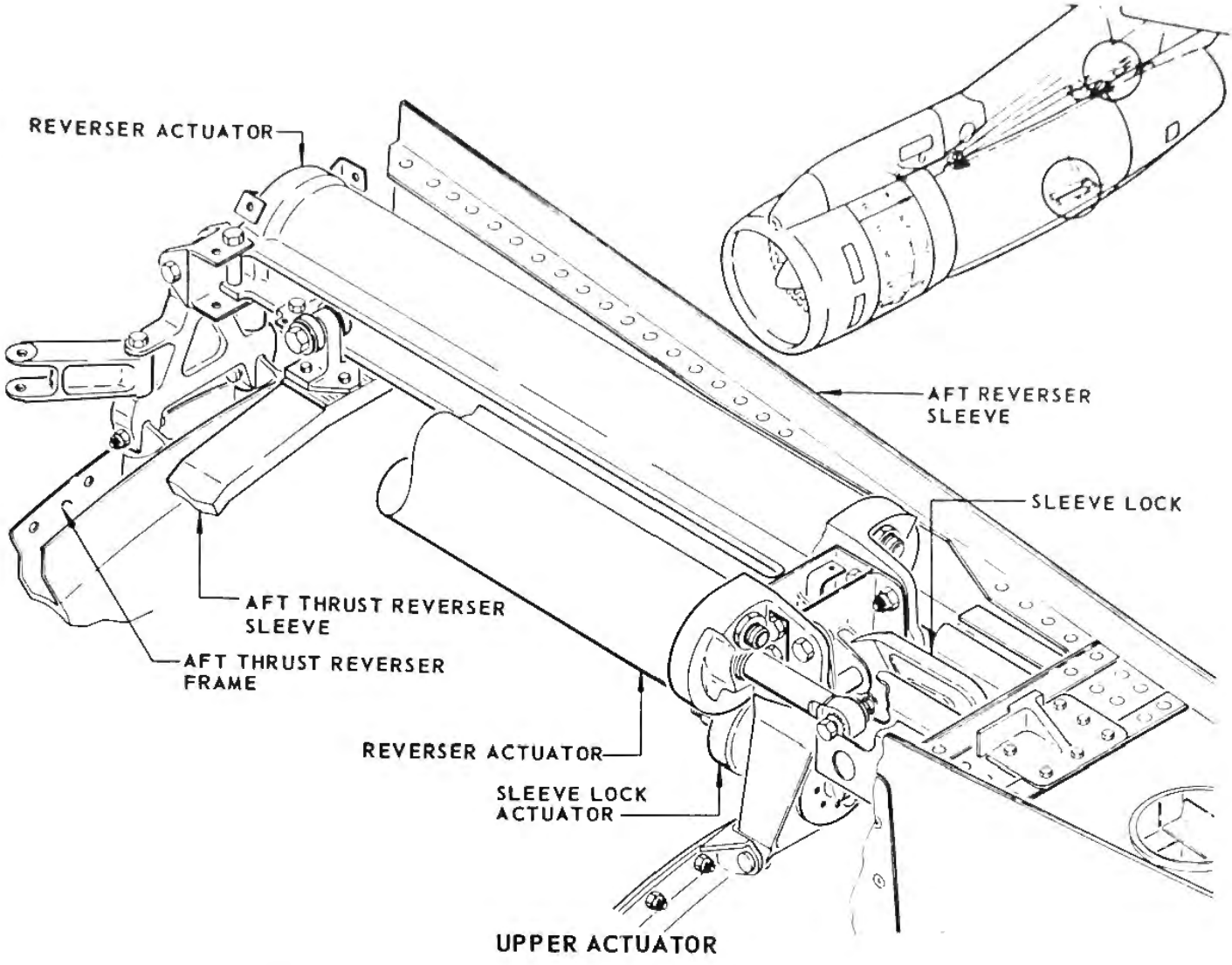
C. The reverse thrust controls direct pneumatic air to the actuators to position the reversers for the forward or reverse thrust position. The forward thrust reverser actuators control the movement of the cowl ring assembly, blocker doors, and lower vane assemblies. The aft thrust reverser actuators control the movement of the aft reverser sleeve which operates the hinge drive mechanism and causes the clamshell doors to open and close.

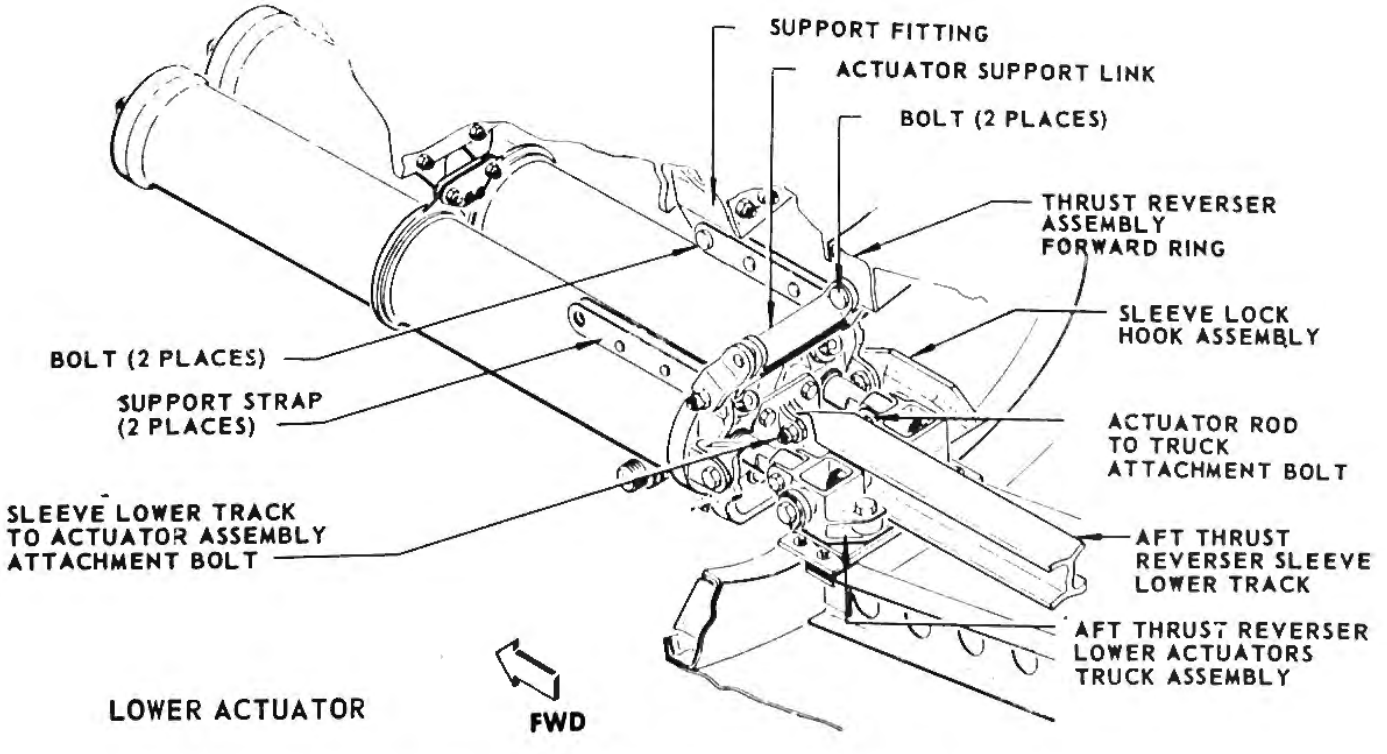
2. Reverse Thrust Controls

A. The reverse thrust controls consist of the thrust reverser directional control valve, forward thrust reverser locking cam, aft thrust reverser locking cam, directional control valve actuating cam, forward thrust reverser follow-up control crank and aft thrust reverser follow-up



Thrust Reverser Control System Component Location
Figure 1





Aft Thrust Reverser Actuator Assemblies
Figure 4

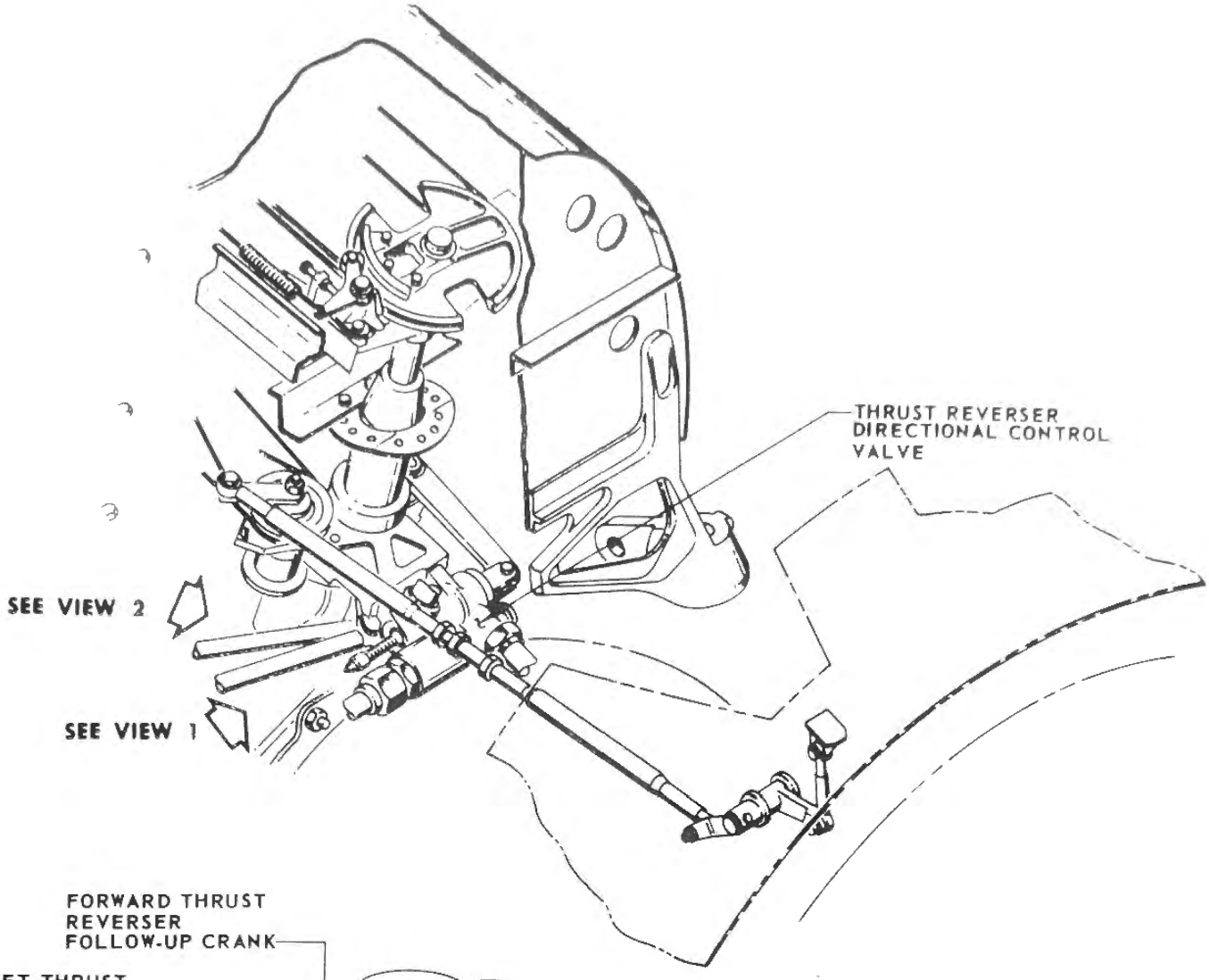
pulley. (See figure 2.) The thrust reverser directional control valve actuating cam is mounted on the thrust control shaft in the engine strut. The valve assembly is on the engine controls strut bracket. The locking cams, follow-up crank and follow-up pulley are mounted on a shaft through the strut bracket. On airplanes VH-EBL and on, the thrust reverser directional valve actuating cam has incorporated on it a spring loaded cam follower for the forward thrust reverser interlock override provisions.

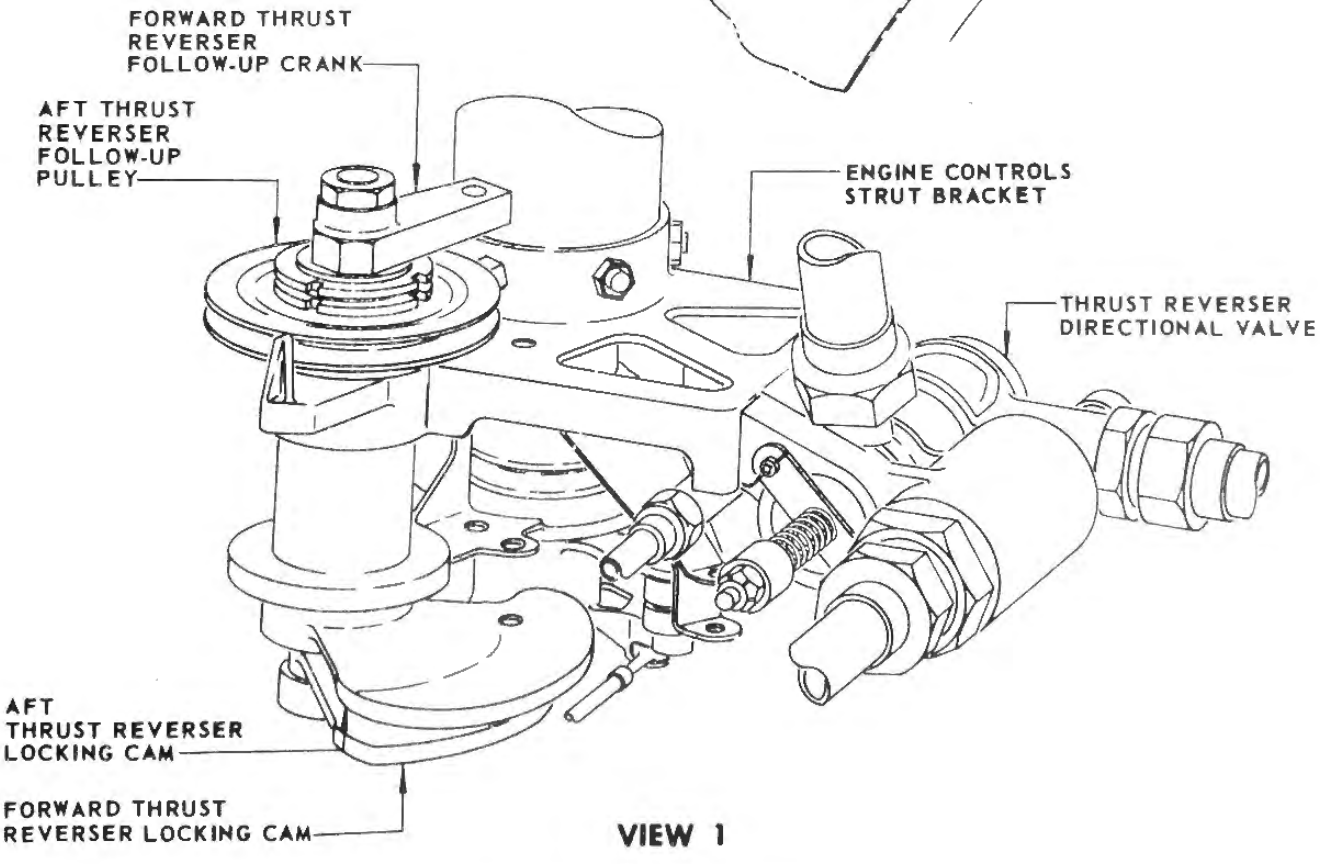
B. The reverse thrust controls operate the thrust reverser directional valve. (See figure 2.) The directional valve actuating cam rotates with the thrust control shaft, causing actuation of the directional valve through a valve control arm and roller mechanism. The forward and aft reverser locking cams contact the directional valve actuating cam to provide lockout of the thrust control shaft at partial thrust condition. When the flow reversing components have been properly positioned to actuate the aft reverser follow-up pulley and forward thrust reverser follow-up crank, the locking cams are repositioned and allow rotation of the thrust control shaft to desired thrust setting.

3. Forward Thrust Reverser Follow-Up Linkage

A. The forward thrust reverser follow-up linkage controls the position of the forward thrust reverser locking cam, preventing application of full forward or reverse thrust until the forward thrust reverser has assumed the correct position for the selected thrust condition. The linkage consists of a rod assembly, linkage connecting the rod assembly to the forward thrust reverser cowl ring assembly, and a follow-up crank connecting the rod assembly through a shaft to the forward thrust reverser locking cam. (See figure 2.) The follow-up linkage is controlled by movement of the cowl ring assembly. The follow-up crank is on the same shaft as the forward thrust reverser locking cam. When the forward thrust reverser is actuated, movement of the cowl ring repositions the follow-up crank, causing the locking cam to be repositioned.

B. On airplanes VH-EBL and on, the spring loaded interlock stop on the directional valve actuating cam contacts the forward thrust reverser follow-up cam. If the follow-up cam does not reposition (forward thrust reverser fails to return to cruise) after cruise thrust has been selected in the control cab increased manual force on the thrust lever will compress the spring loaded stop and rotate the thrust control shaft to obtain increased thrust. Rotation will continue till a second (absolute) stop on the directional valve cam contacts the locking cam.

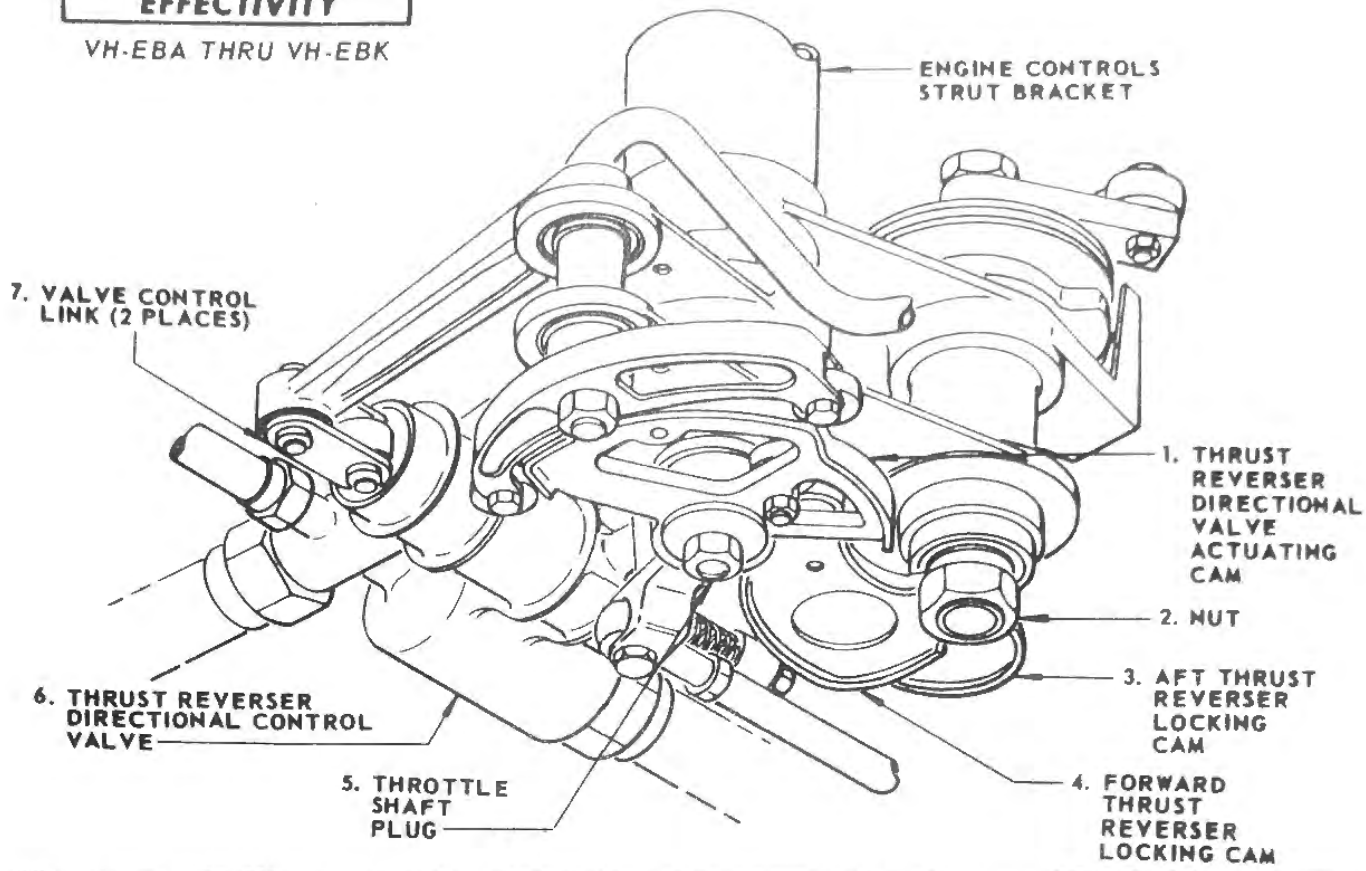

THRUST REVERSER DIRECTIONAL CONTROL VALVE
SEE VIEW 2
SEE VIEW 1


FORWARD THRUST REVERSER FOLLOW-UP CRANK
AFT THRUST REVERSER FOLLOW-UP PULLEY
ENGINE CONTROLS STRUT BRACKET
THRUST REVERSER DIRECTIONAL VALVE
AFT THRUST REVERSER LOCKING CAM
FORWARD THRUST REVERSER LOCKING CAM

VIEW 1

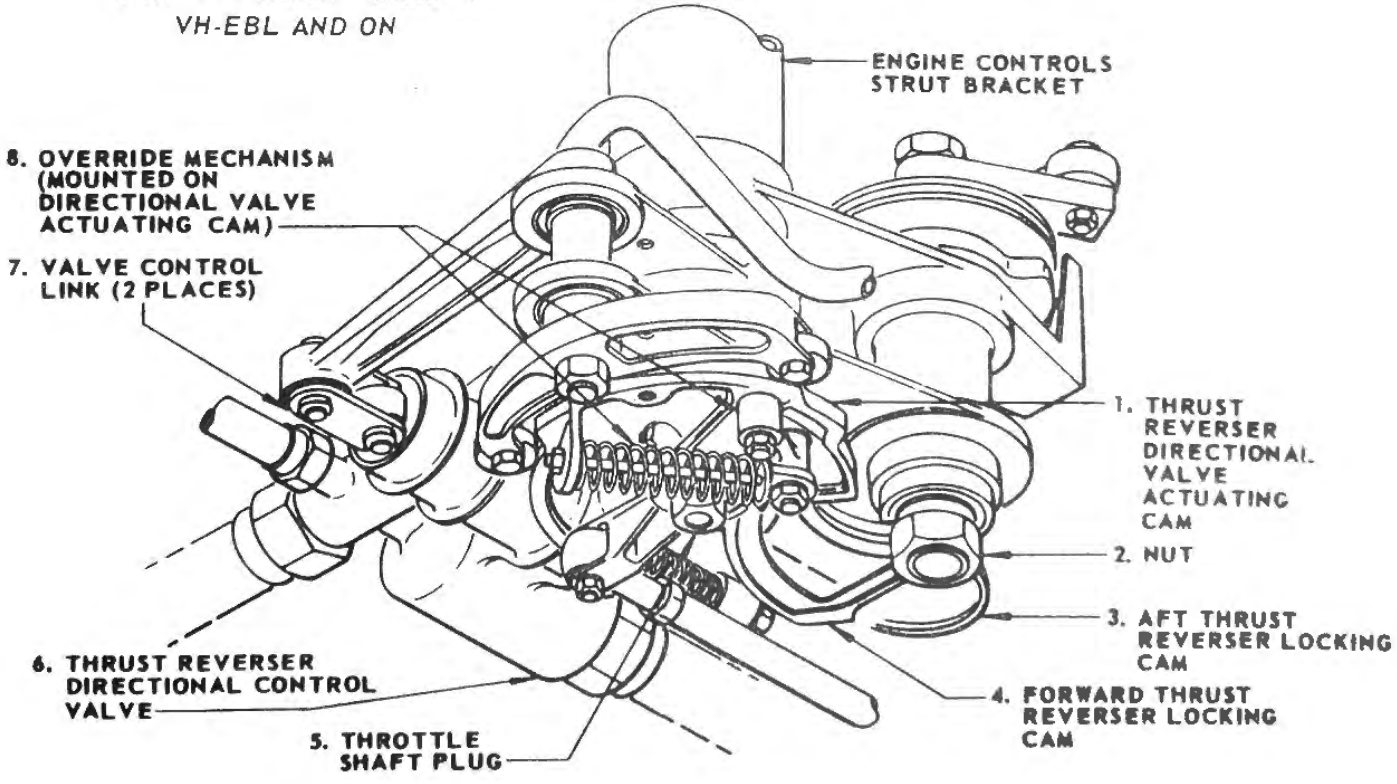
EFFECTIVITY

VH-EBA THRU VH-EBK



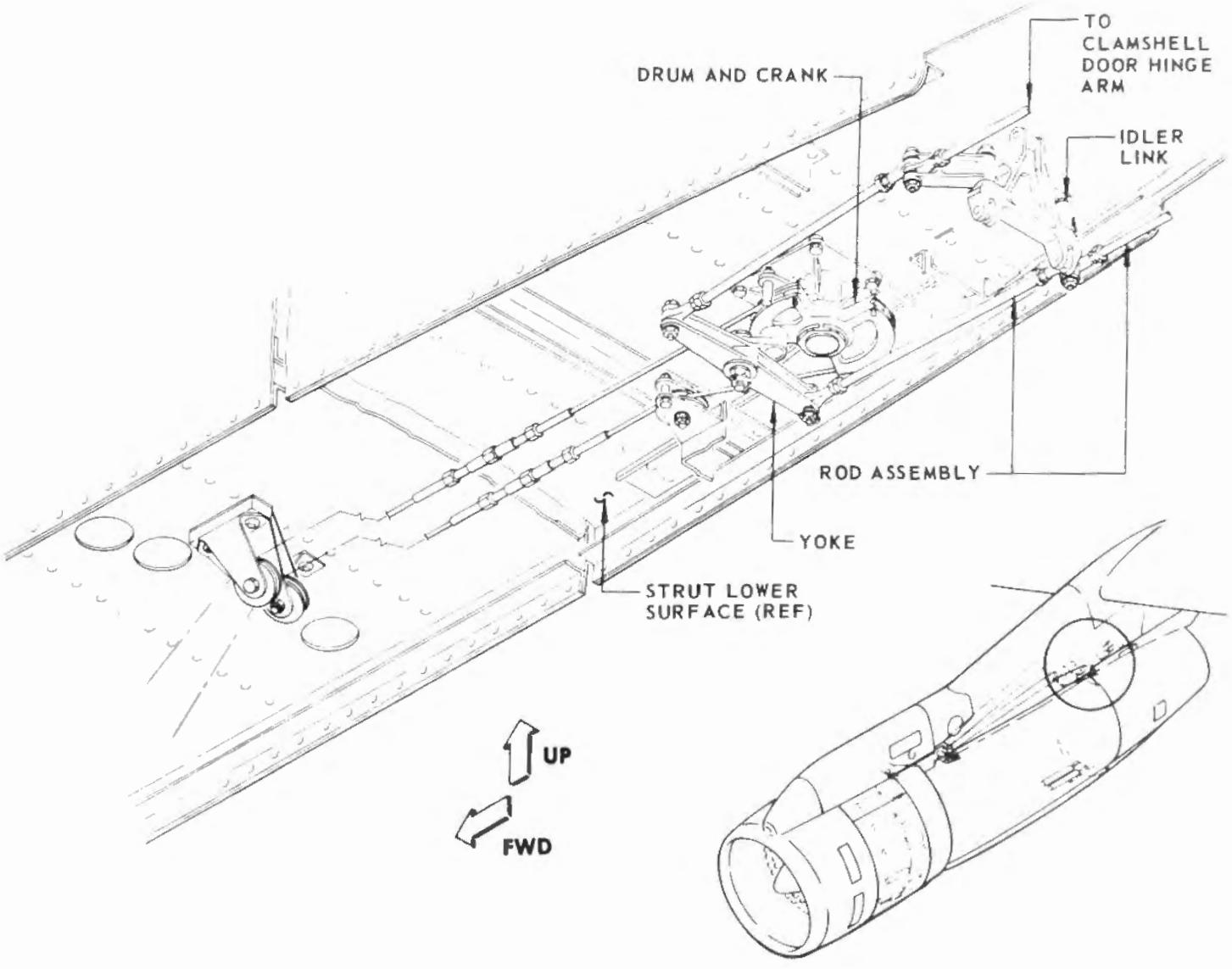
EFFECTIVITY

VH-EBL AND ON



4. Aft Thrust Reverser Follow-Up Linkage

A. The aft thrust reverser follow-up linkage controls the position of the aft thrust reverser locking cam, preventing application of full forward or reverse thrust until the aft thrust reverser has moved to the correct position for the selected thrust condition. The linkage consists of a follow-up pulley mounted on a shaft at the engine controls strut bracket; a yoke and a drum and crank assembly mounted on the strut and connected to the follow-up pulley by a cable; and idler links and rod assemblies connecting the clamshell door hinge arm to the yoke. (See figure 3.) Movement of the hinge drive mechanism operates the follow-up linkage, causing rotation of the follow-up pulley. The aft thrust reverser locking cam is mounted on the same shaft as the follow-up pulley, and is repositioned by rotation of the shaft.



Aft Thrust Reverser Follow-up Linkage
Figure 3

5. Forward Thrust Reverser Actuators

A. The forward thrust reverser actuators operate the cowl ring assembly, blocker doors, and lower vane assemblies. The actuators consist of the actuator housing and piston rod assembly. (See figure 1.) There are fourteen actuators located circumferentially around the engine. Twelve of these actuators are identical and operate the blocker doors and the baffle assemblies. The other two actuators are smaller, have a shorter stroke, and operate the vane assemblies. The blocker doors, vane assemblies, and baffle assemblies are connected to the cowl ring assembly. The actuator piston rod ends are connected to the blocker doors and lower vane assemblies. For forward thrust operation, pneumatic pressure enters the rod ports of the actuators pulling the blocker doors forward and out of the fan air duct to lay flat around the compressor case. The vane assemblies move forward also. The cowl ring assembly is repositioned forward to exhaust the fan air in an aft direction. For reverse thrust operation, air enters the head ports of the actuators to move the cowl ring aft and reposition the blocker doors, vane assemblies and baffle assemblies to discharge the fan exhaust air in a forward direction.

6. Aft Thrust Reverser Actuator Assemblies

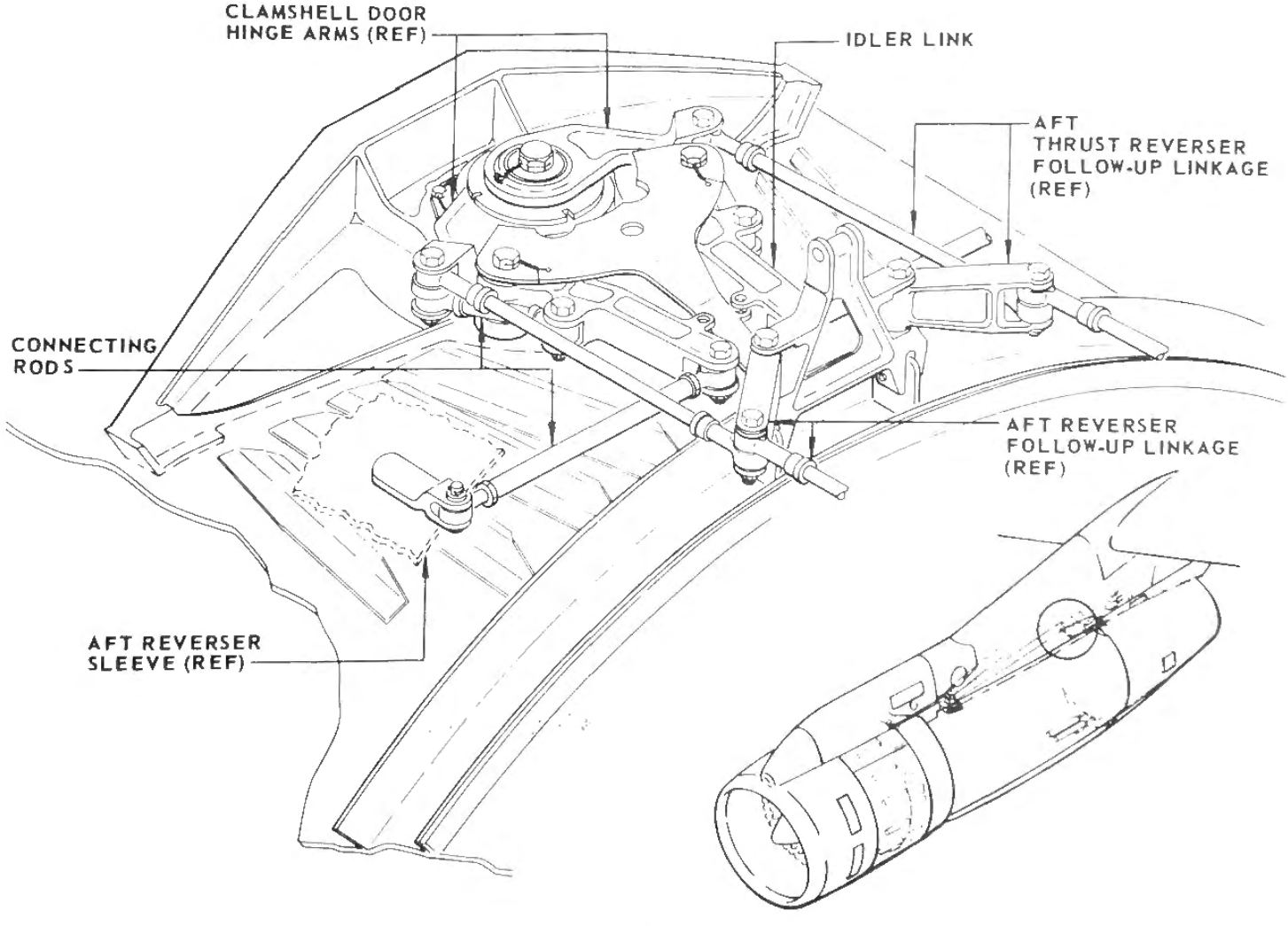
A. Upper and lower actuator assemblies, each consisting of two reverser actuators, a sleeve lock actuator, and a sleeve lock, move the aft thrust reverser sleeve forward and aft causing the clamshell doors to open and close through the action of the hinge drive mechanism. (See figure 4.) The upper actuator assembly is on top of the thrust reverser. The lower actuator assembly is on the underside of the engine, forward of the thrust reverser forward mounting ring. The reverser actuators consist of the actuator housing, piston, and piston rod. The piston rod ends of the lower actuators are connected to a truck assembly which is mounted on the sleeve and rides on a track attached to the thrust reverser frame and to the rod port end of the actuators. The piston rod ends of the upper actuators are connected to the sleeve structure. A roller truck assembly mounted on the upper surface of the sleeve forward ring rides in a track formed by the upper actuators. The sleeve lock actuators consist of the actuator housing, piston, and piston rod. The piston rod ends are connected to the sleeve locks.

B. For reverse thrust operation, pneumatic pressure enters the head port of the lower lock actuator, forcing the piston rod to actuate the lower sleeve lock, releasing the sleeve at the lower truck assembly and uncovering the port to the upper lock actuator pressure line, causing the upper lock to actuate and release the sleeve, and uncovering a port to

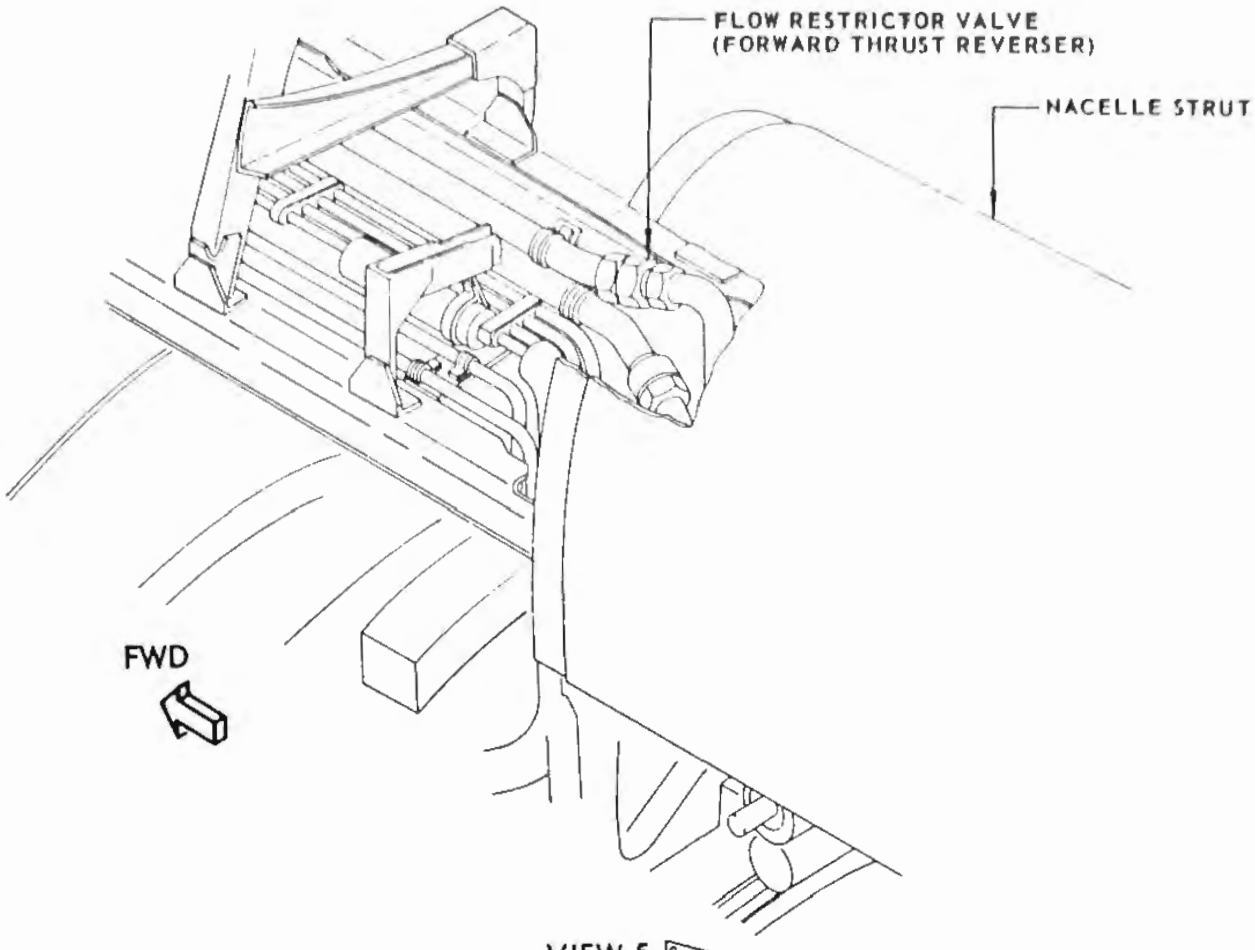
pressurize the lines to the reverser actuator head ports. The reverser actuator piston rods force the sleeve aft by forcing the truck assembly to move toward the aft end of the guide track. For forward thrust operation, pressure is routed directly from the directional control valve to the rod ports of the reverser actuators, causing the piston rods to drive the sleeve forward until it engages the sleeve locks at the end of its forward travel.

7. Hinge Drive Mechanism

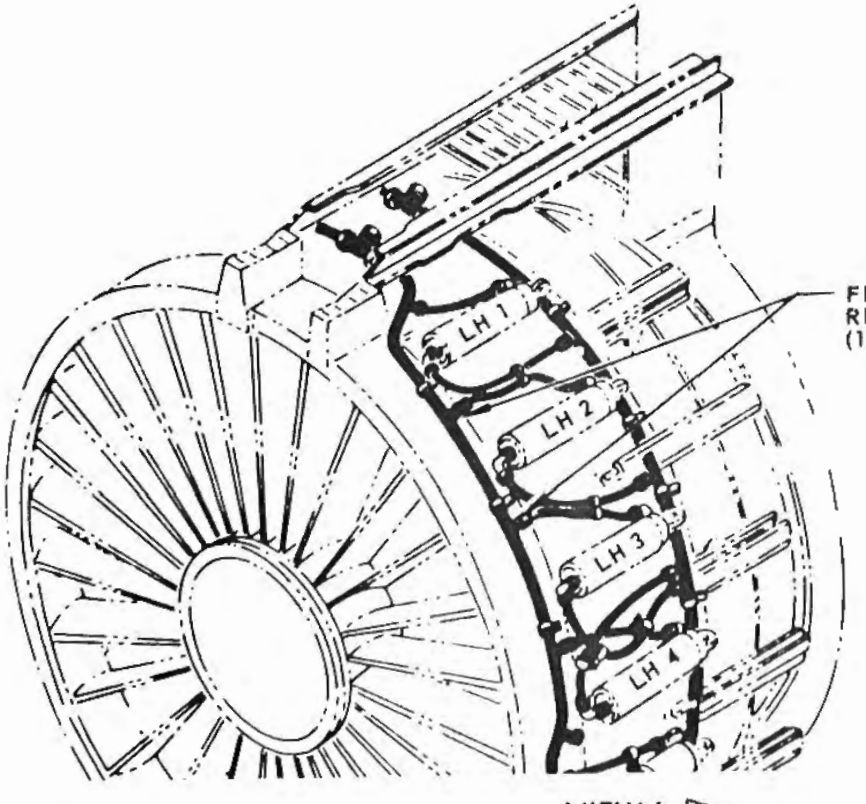
A. The hinge drive mechanism, when operated by movement of the aft reverser, causes the clamshell doors to open and close by driving the clamshell door hinge arms. The mechanisms for the upper and lower clamshell door hinge arms are identical and each consists of two idler links and four connecting rod assemblies. (See figure 5.) Two of the rod assemblies connect the aft reverser sleeve to the idler links. The other two short rod assemblies connect the idler links to the clamshell door hinge arms. Movement of the aft reverser sleeve forward or aft causes the two long rod assemblies to rotate the idler links which in turn drive the clamshell door hinge arms through the short rod assemblies.



Hinge Drive Mechanism
Figure 5



VIEW 5 [2]



VIEW 6 [2]

[2] SOME INSTALLATIONS HAVE PLUMBING AS SHOWN IN VIEW 5. ALL OTHER INSTALLATIONS HAVE PLUMBING AS SHOWN ON VIEW 6.

Thrust Reverser Miscellaneous Control System Components
Figure 6 (Sheet 4 of 4)

8. Miscellaneous Control System Components

A. Aft Thrust Reverser Pressure Relief Valves

(1) There are two pressure relief valves located in the aft thrust reverser pneumatic tubing. One of the valves is located in the line between the thrust reverser directional valve and the lower lock actuator at the forward end of the lower lock actuator. (See view 1, figure 6.) The other relief valve is in the line between the lower lock actuator and the upper lock actuator. The relief valves preclude excessive static torque on the clamshell door hinge shafts. The valves are set to relieve at 60 (± 5) psig. (See figure 6.)

B. Pneumatic Supply Check Valves

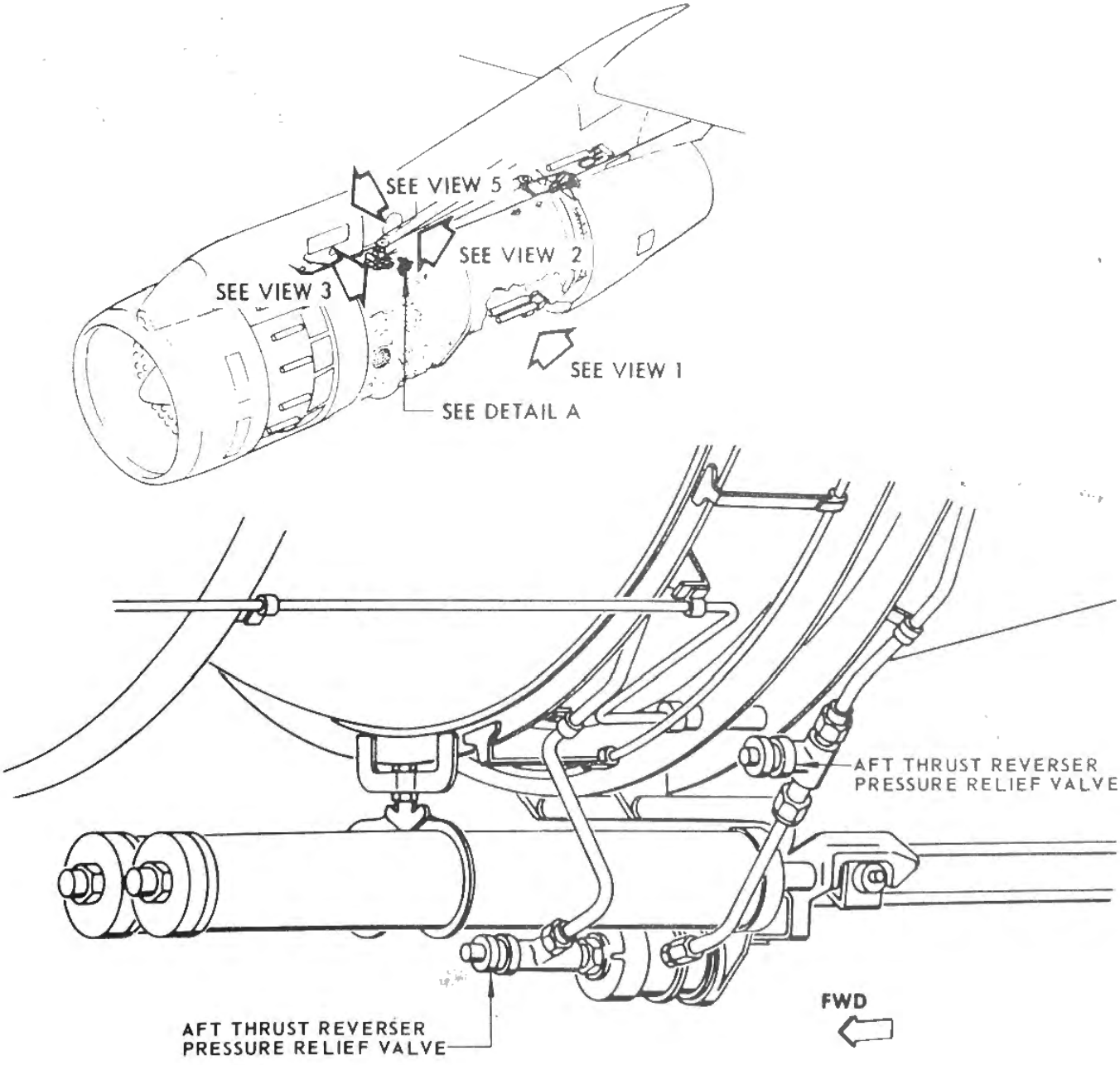
(1) Two check valves in the thrust reverser pneumatic lines allow pneumatic air to be directed to the thrust reverser directional control valve from either the engine diffuser casing (N_2 compressor delivery air) or from an external pressure source through the ground service connection. On some installations the engine air supply check valve is located at the pneumatic supply line take-off from the turbocompressor duct on the upper left-hand side of the engine. (See detail A, figure 6.) On all other installations the engine air check valve is located at the thrust reverser pneumatic plumbing engine bleed connection on the right-hand side of the engine. (See view 4.) The other check valve is in the line from the ground service connection in the nacelle strut. (See view 2, figure 6.) A tee connection joins the pneumatic lines from the two pressure sources to the supply line to the thrust reverser directional valve. If pneumatic pressure is being applied from either source through the check valve in that line, the other check valve prohibits air flow in the line from the other source.

C. Forward Thrust Reverser Flow Restrictor Valve

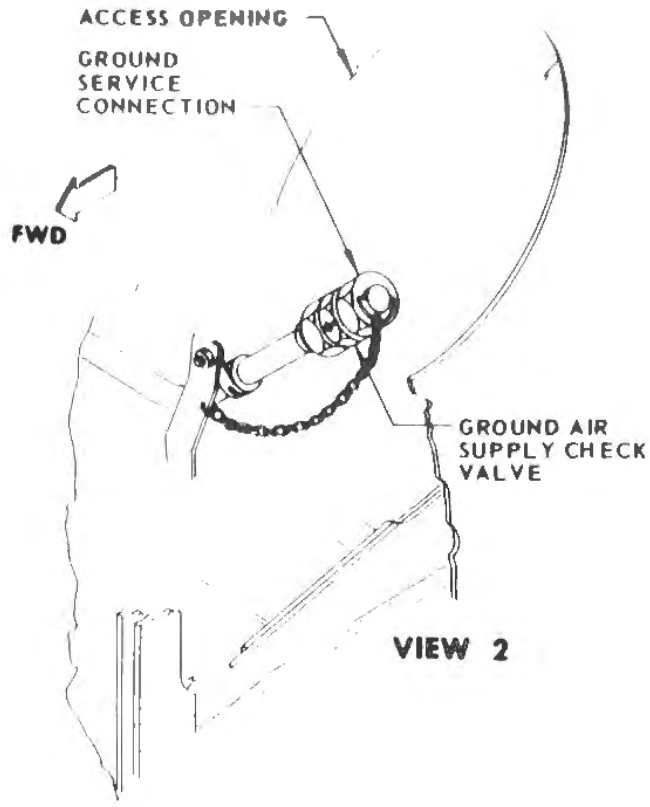
(1) On some installations a one way flow restrictor valve in the thrust reverser pneumatic plumbing provides snubbing action for the forward thrust reverser actuators during reverse thrust actuation. (See view 3, figure 6.) The valve is in the pneumatic line to the rod ports of the forward thrust reverser actuators, located under the turbocompressor fairing or, on engines not having the turbocompressor, under the strut forward fairing. The valve is essentially a check valve designed to restrict air flow in one direction and allow free flow in the opposite direction.

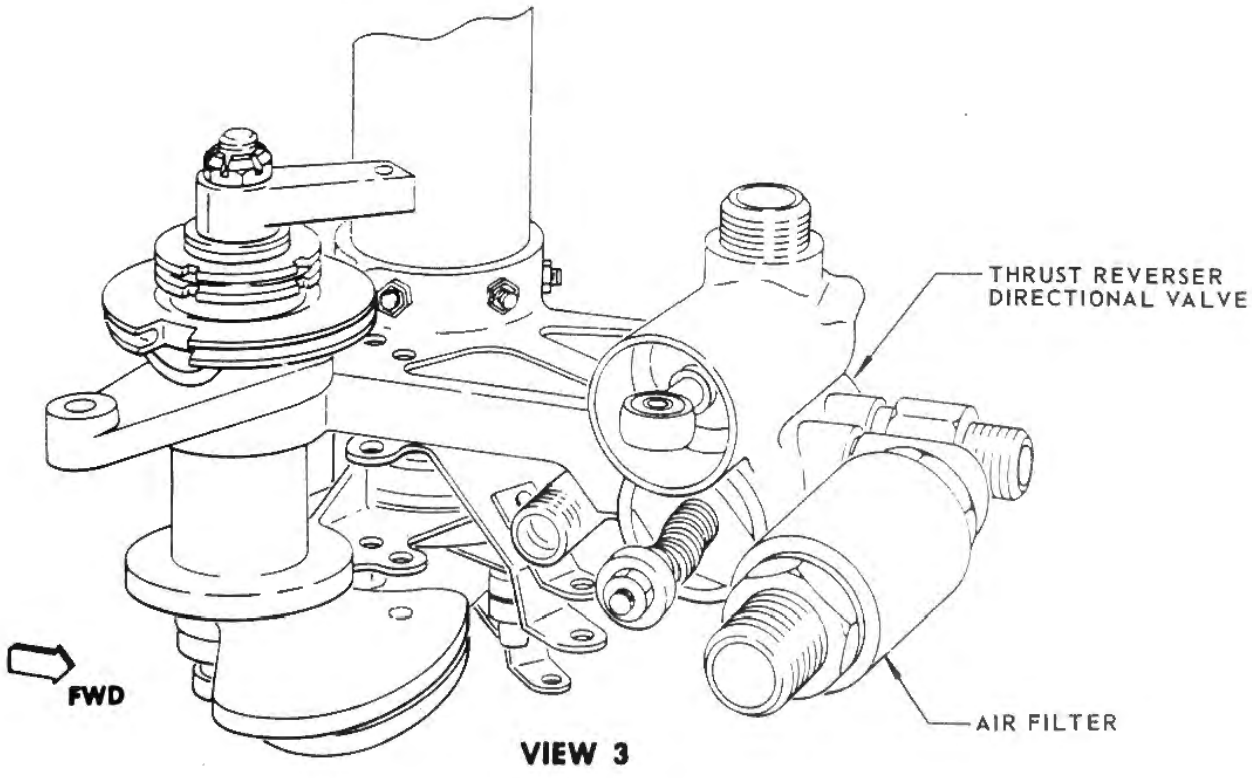
When pneumatic air enters the head ports of the actuators, pushing the piston aft, trapped air is forced out the rod ports. The air flow is restricted at the restrictor valves, providing the snubbing action. The restrictor valve allows free flow in the opposite direction for forward thrust operation.

(2) On all other installations an individual flow restrictor orifice is located at each of the actuator locations at the bulkhead connection between the "cruise" manifold and the individual actuator lines (14 places). The individual flow restrictor orifice provides snubbing action for the forward thrust reverser actuators during reverse thrust actuation. When pneumatic air enters the head ports of the actuators, pushing the pistons aft, trapped air is forced out the rod ports. The flow of this air is restricted at each of the individual orifices, providing the snubbing action.

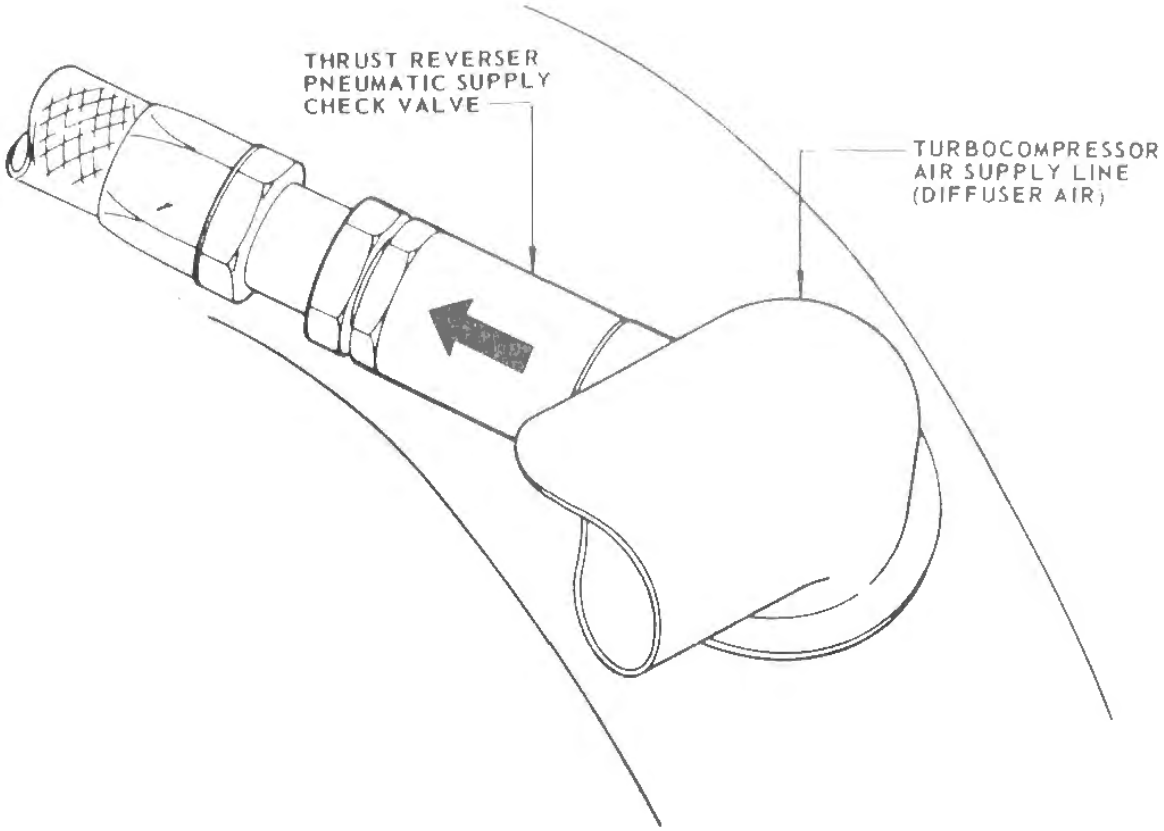


Thrust Reverser Miscellaneous Control System Components
Figure 6 (Sheet 1 of 4)

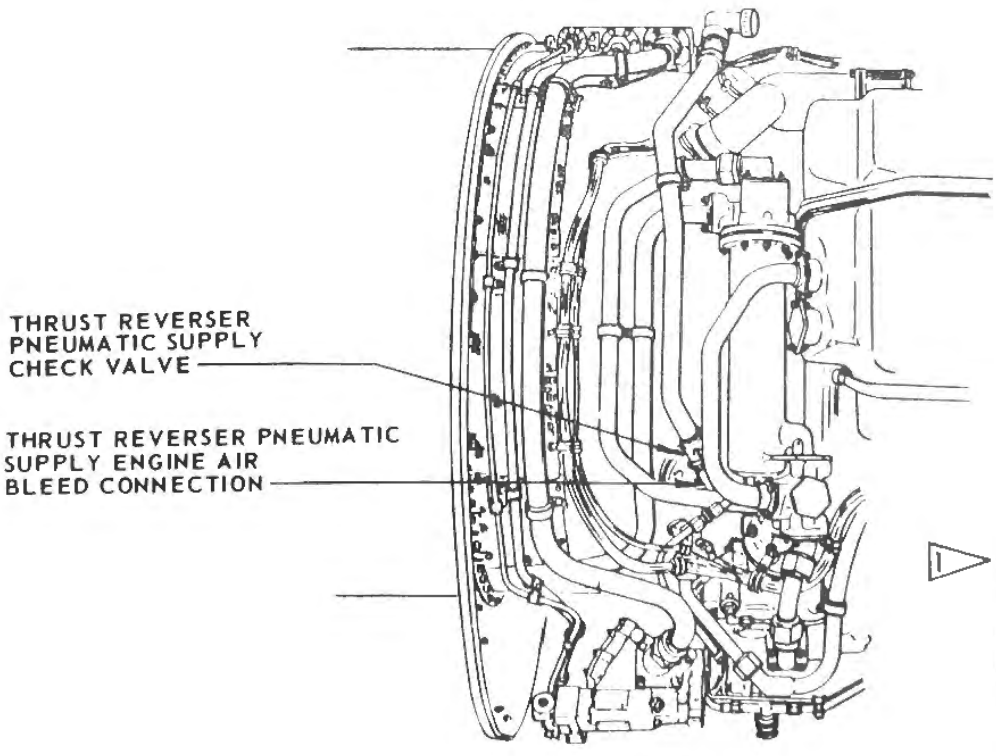




Thrust Reverser Miscellaneous Control System Components
Figure 6 (Sheet 2 of 4)



DETAIL A ▷1



▷1 SOME INSTALLATIONS HAVE PLUMBING AS SHOWN IN DETAIL A. ALL OTHER INSTALLATIONS HAVE PLUMBING AS SHOWN IN VIEW 4.

RH SIDE OF ENGINE

VIEW 4 ▷

D. Air Filter

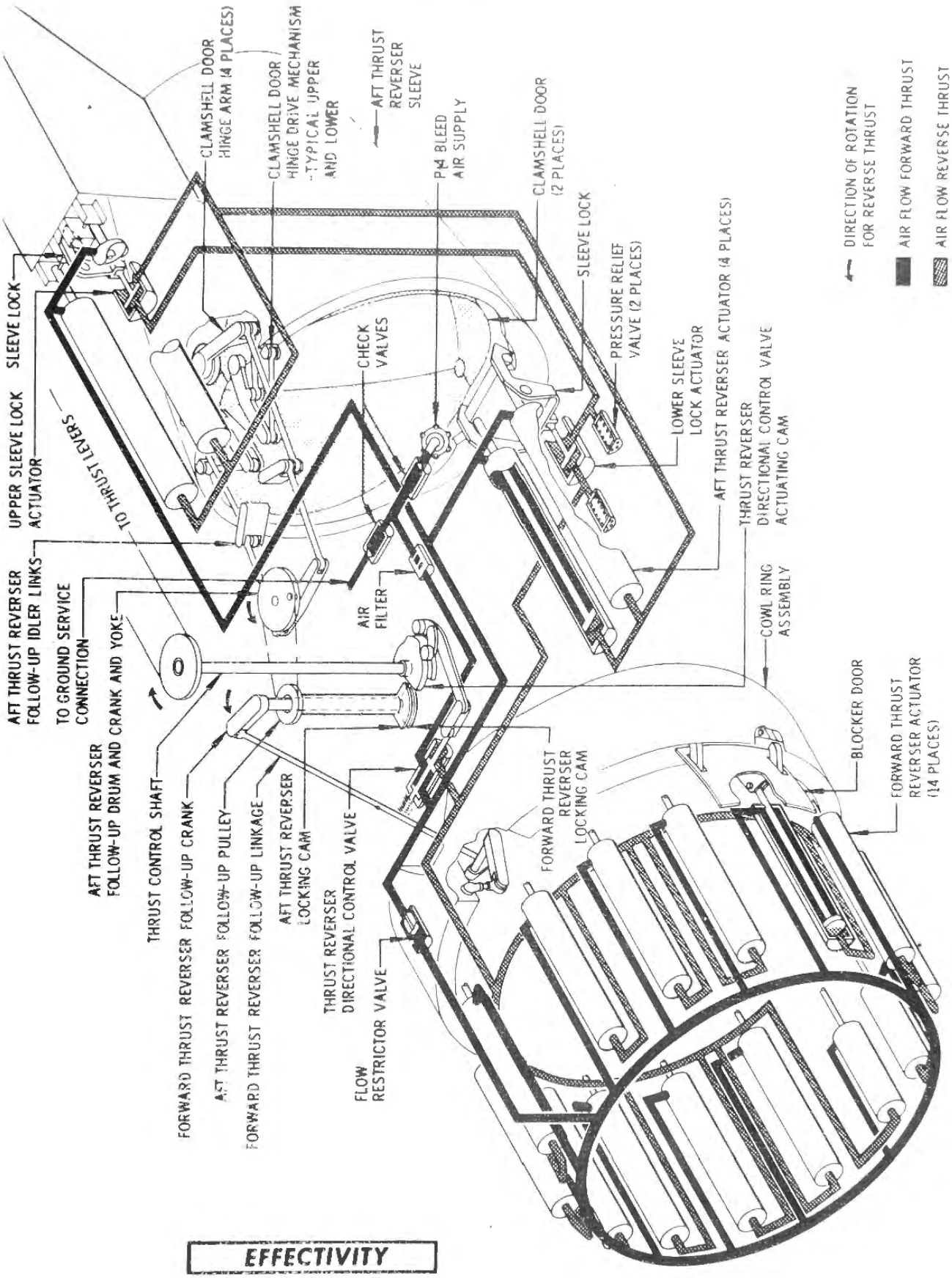
(1) An air filter is provided to prevent contamination of the pneumatic system. (See view 4, figure 6.) The screen in the filter can be removed for cleaning or replacement. The air filter is in the line between the air source tee connection and the thrust reverser directional valve and is located at the directional valve.

9. Operation

A. The thrust reverser control system is actuated and controlled entirely by use of the reverse thrust lever. (See figure 7.) Pneumatic pressure is normally supplied from the engine diffuser casing. During ground tests, an external air source may be connected to the ground service connection to supply air pressure to the system.

B. During forward thrust operation, the thrust reverser directional valve maintained in the forward thrust position by the directional control valve actuating cam on the thrust control shaft, directs pneumatic air to the rod ports of the forward thrust reverser actuators and the aft thrust reverser actuators to hold the forward and aft thrust reversers in the forward thrust position. If the forward or aft thrust reverser moves to reverse thrust position during forward thrust operation, the forward or aft thrust reverser follow-up mechanism will rotate the respective locking cam which will contact the directional control valve actuating cam on the control shaft, forcing the shaft to an interlock position, thus reducing engine thrust. If either of the reversers move to the forward thrust position during reverse thrust operation, the thrust control shaft will be forced back to an interlock position thereby reducing engine thrust.

C. For reverse thrust operation, the forward thrust lever must be returned to idle before the reverse thrust lever can be moved sufficiently to initiate reverse thrust operation. This prevents accidental actuation of the reversers during forward thrust operation. Initial movement of the reverse thrust lever to an interlock position rotates the thrust reverser directional valve actuating cam to reposition the directional valve, directing high pressure air to the head ports of the forward and aft reverser actuators. The forward and aft reverser locking cams



EFFECTIVITY

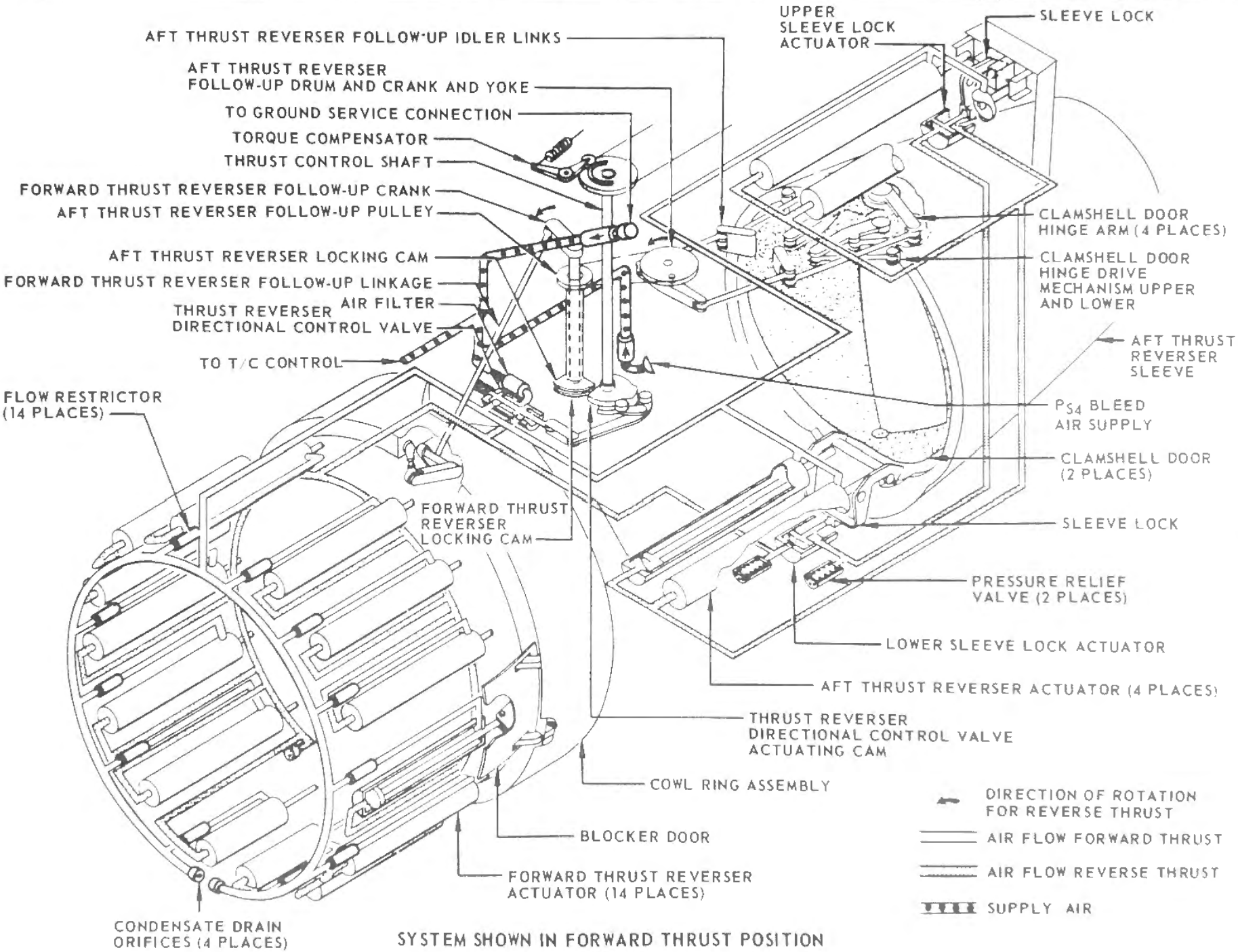
EARLY INSTALLATIONS ONLY.
SHEET 2 REFLECTS PLUMBING CHANGES ON LATER INSTALLATIONS.

Thrust Reverser Control System Schematic
Figure 7 (Sheet 1 of 2)

CHAPTER 76

ENGINE CONTROLS

TABLE OF CONTENTS



Thrust Reverser Control System Schematic
Figure 7 (Sheet 2 of 2)

prohibit further movement of the reverse thrust lever until the clamshell doors on the aft reverser and the forward thrust reverser cowl ring assembly approach the full reverse thrust position. As the clamshell doors approach the full reverse thrust position, movement of the aft reverser follow-up linkage repositions the aft reverser locking cam. As the cowl ring assembly approaches the full reverse thrust position, movement of the forward thrust reverser follow-up linkage repositions the forward thrust reverser locking cam. Repositioning of both the cams allows the reverse thrust lever to be moved toward the maximum reverse thrust position.

D. For return to forward thrust operation, the reverse thrust lever is returned to idle, causing the thrust reverser directional valve actuating cam on the thrust control shaft to rotate, repositioning the directional valve to the forward thrust position, thus directing air to the forward and aft thrust reverser actuators for forward thrust operation. When the forward thrust reverser and aft thrust reverser have nearly reached the full forward thrust position, the forward thrust reverser follow-up linkage and the aft thrust reverser follow-up linkage reposition the respective locking cams allowing the forward thrust lever to be moved past the interlocked position to increase forward thrust. On airplanes VH-EBL and on, the spring loaded forward reverser follow-up stop on the directional valve actuating cam prevents application of increased forward thrust until either the forward thrust reverser locking cam is repositioned or, if the forward reverser does not move to the "cruise" position, increased manual force is applied to the forward thrust lever, forcing the directional valve actuating cam to rotate, compressing the spring loaded interlock stop. If the forward reverser should now fail to return to "cruise" position, a second (fixed) stop on the directional valve cam will contact the follow-up cam, preventing further control shaft rotation or further increase in forward thrust.

THRUST REVERSER CONTROL SYSTEM - TROUBLE SHOOTING

1. General

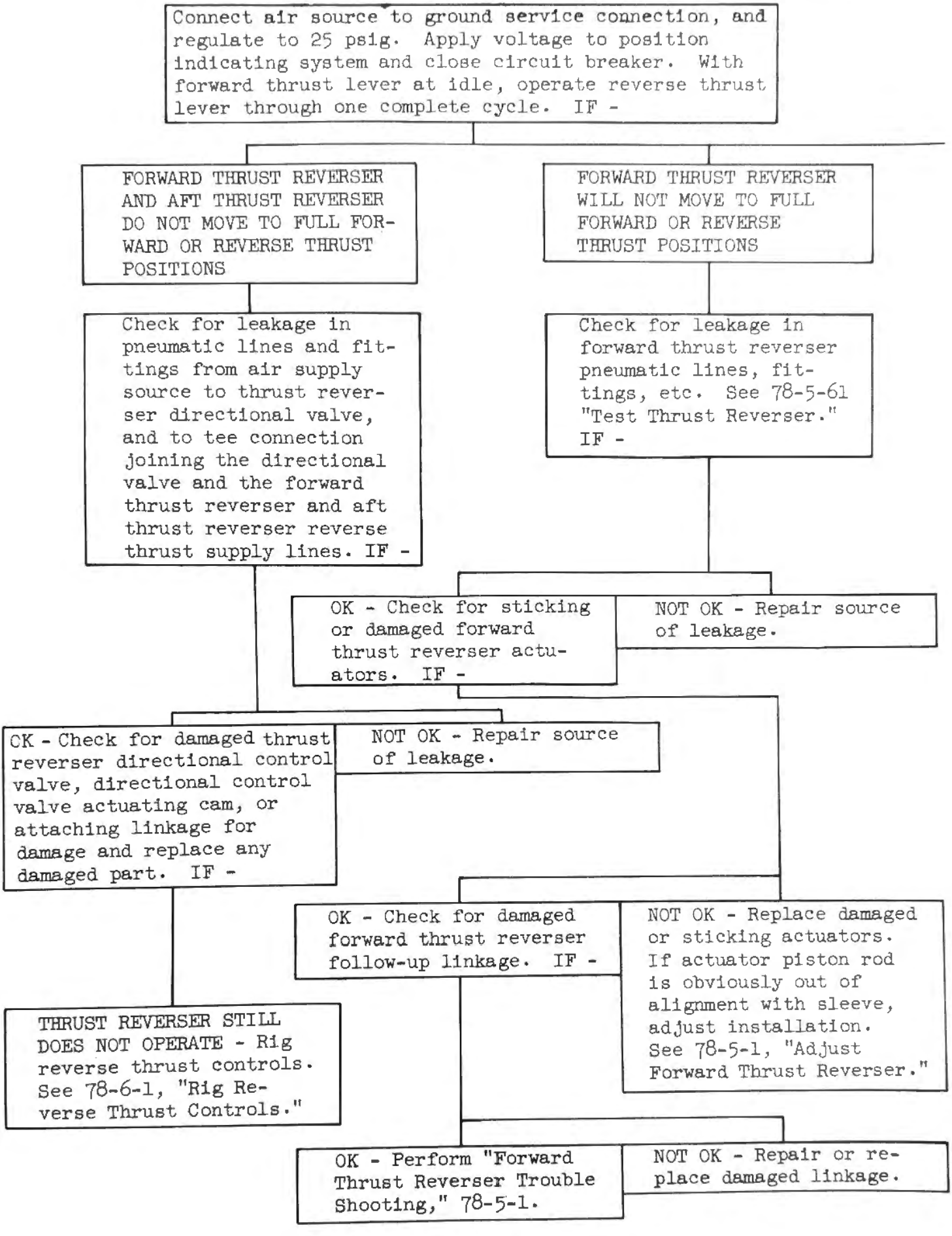
A. Trouble shooting can be performed on the thrust reverser control system without operating the engines. An external dry air source capable of supplying a pressure of 60 psig is satisfactory for trouble shooting the system. Caution must be exercised when using an external air source to avoid violent operating speeds.

WARNING: PERSONNEL MUST STAY CLEAR OF THE ENGINE WHILE THE THRUST REVERSER IS BEING ACTUATED, TO PREVENT INJURY TO PERSONNEL. PLACARD CONTROL STAND TO WARN AGAINST ACTUATION OF THRUST LEVERS WHILE THRUST REVERSER IS BEING WORKED ON.

CAUTION: MAKE SURE ENGINE COWL PANELS ARE CLOSED AND FAN COWL PANELS ARE REMOVED BEFORE CONNECTING GROUND AIR SUPPLY TO PREVENT STRUCTURAL OR ENGINE DAMAGE OR PERSONNEL INJURY.

THE SUPPLY LINE BETWEEN THE SUPPLY PRESSURE REGULATOR AND THE GROUND AIR CONNECTION SHALL HAVE A MINIMUM INSIDE DIAMETER OF 9/32 INCH.

2. Thrust Reverser Control System Trouble Shooting Chart


Connect air source to ground service connection, and regulate to 25 psig. Apply voltage to position indicating system and close circuit breaker. With forward thrust lever at idle, operate reverse thrust lever through one complete cycle. IF -
FORWARD THRUST REVERSER AND AFT THRUST REVERSER DO NOT MOVE TO FULL FORWARD OR REVERSE THRUST POSITIONS
FORWARD THRUST REVERSER WILL NOT MOVE TO FULL FORWARD OR REVERSE THRUST POSITIONS
Check for leakage in pneumatic lines and fittings from air supply source to thrust reverser directional valve, and to tee connection joining the directional valve and the forward thrust reverser and aft thrust reverser reverse thrust supply lines. IF -
Check for leakage in forward thrust reverser pneumatic lines, fittings, etc. See 78-5-61 "Test Thrust Reverser." IF -
OK - Check for sticking or damaged forward thrust reverser actuators. IF -
NOT OK - Repair source of leakage.
CK - Check for damaged thrust reverser directional control valve, directional control valve actuating cam, or attaching linkage for damage and replace any damaged part. IF -
NOT OK - Repair source of leakage.
OK - Check for damaged forward thrust reverser follow-up linkage. IF -
NOT OK - Replace damaged or sticking actuators. If actuator piston rod is obviously out of alignment with sleeve, adjust installation. See 78-5-1, "Adjust Forward Thrust Reverser."
THRUST REVERSER STILL DOES NOT OPERATE - Rig reverse thrust controls. See 78-6-1, "Rig Reverse Thrust Controls."
OK - Perform "Forward Thrust Reverser Trouble Shooting," 78-5-1.
NOT OK - Repair or replace damaged linkage.

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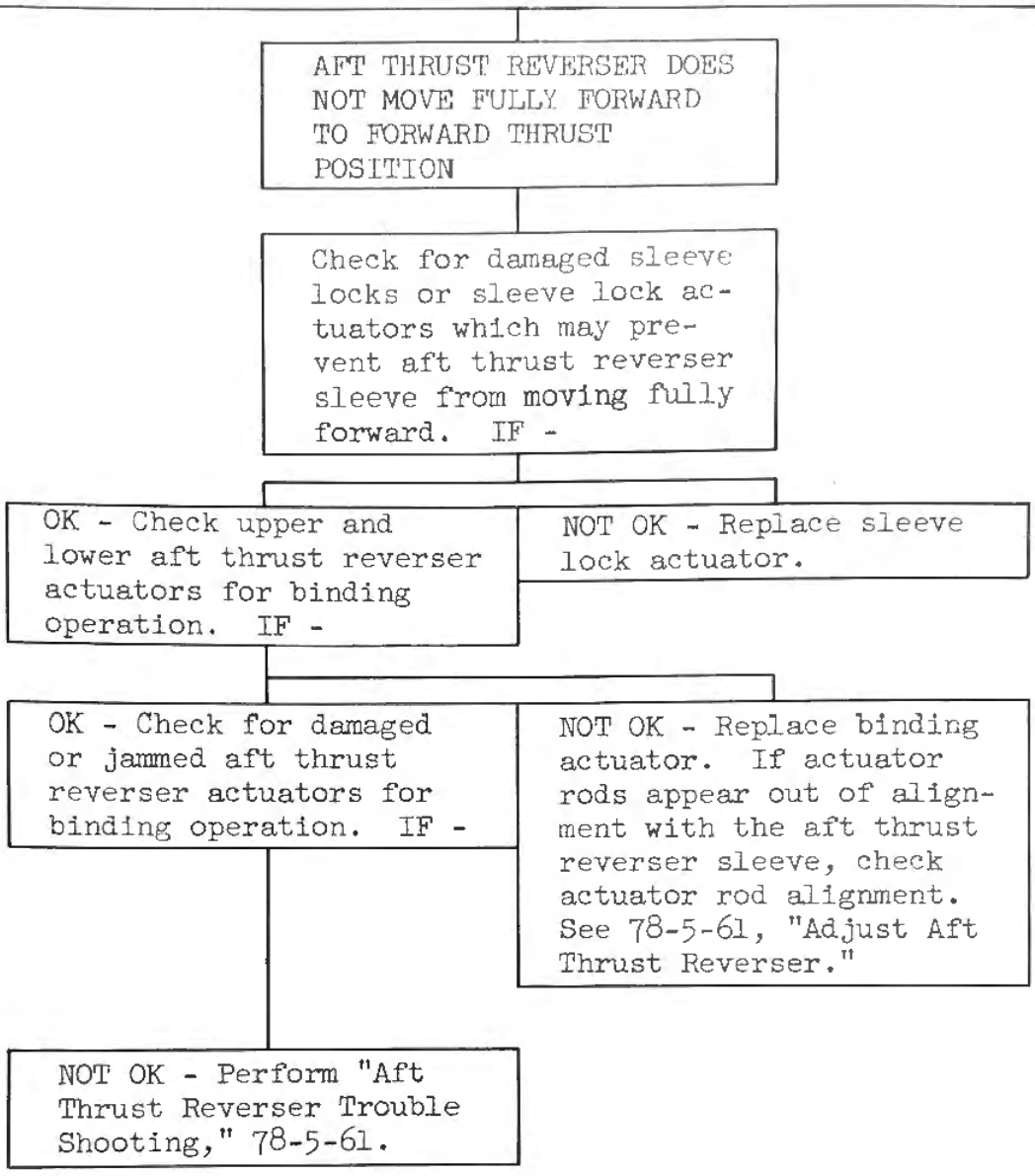

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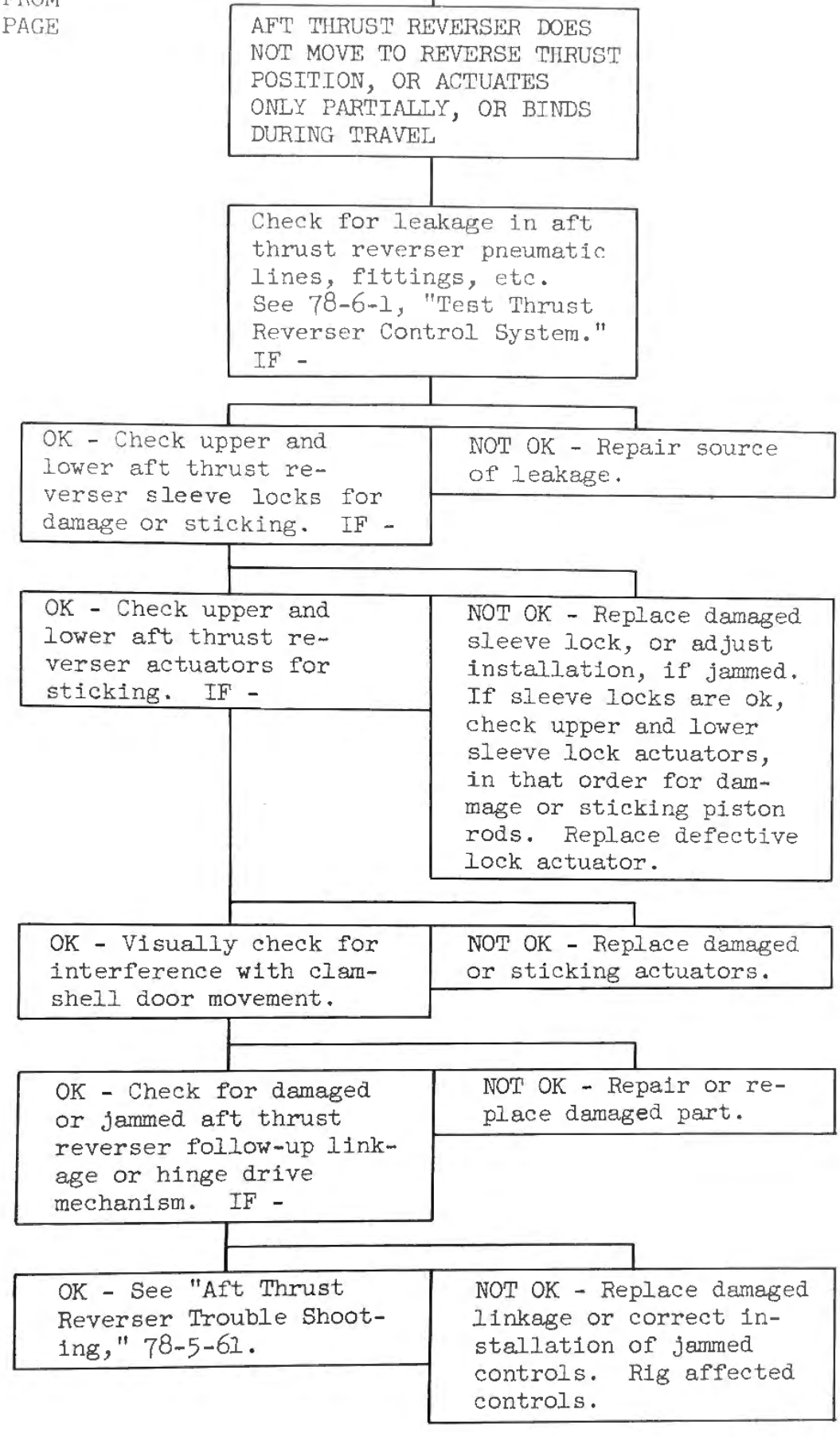


THRUST REVERSER CONTROL SYSTEM - MAINTENANCE PRACTICES

1. Adjustment/Test Thrust Reverser Control System

A. General

(1) Rigging of the thrust reverser control system consists of rigging the forward and aft thrust reverser follow-up linkage. See 78-6-11, "Adjustment/Test Forward Thrust Reverser Follow-Up Linkage," and 78-6-21, "Adjustment/Test Aft Thrust Reverser Follow-Up Linkage."

(2) The thrust reverser control system may be tested without operating the engines. An external air source capable of supplying a pressure of 60 psig is satisfactory for checking the system. Caution must be exercised when operating the system with an external air source to avoid violent operating speeds. The thrust reverser warning light system provides indication of forward thrust reverser cowl ring position and aft thrust reverser sleeve position. Refer to 78-7-0.

WARNING: PERSONNEL MUST STAY CLEAR OF ENGINE WHEN THRUST REVERSER IS BEING ACTUATED. A PLACARD SHOULD BE PLACED ON CONTROL STAND WARNING AGAINST ACTUATION OF THRUST LEVERS WHILE PERSONNEL ARE WORKING ON THRUST REVERSER.

B. Equipment and Materials

(1) Air pressure source - 0 to 60 psig adjustable, using dry air.

(2) Spring scale - 0 to 50 pounds capacity.

C. Test Thrust Reverser Control System

(1) Place forward and reverser thrust levers at "IDLE," and placard control stand to warn against actuation of thrust levers when personnel are working on thrust reverser.

(2) Connect ground air supply.

(a) Close engine side cowl panels and remove fan cowl panels.

WARNING: GROUND AIR SUPPLY MUST NOT BE CONNECTED UNLESS THE ENGINE SIDE COWL PANELS ARE COMPLETELY CLOSED AND FAN COWL PANELS REMOVED, TO AVOID STRUCTURAL OR ENGINE DAMAGE OR PERSONNEL INJURY.

(b) Disconnect and cap thrust reverser pneumatic line to engine bleed connection. Make disconnection at engine end of flexible hose in line and cap flexible hose.

NOTE: This step is necessary on engines on which the check valve at the thrust reverser 16th stage bleed connection on the engine has been reworked to remove the internal parts (flapper and hinge) to preclude possible internal failure on this valve. Therefore, disconnection and capping of the line is necessary to prevent ground service air from venting to atmosphere through the open check valve into the engine.

It is not necessary to perform this step on airplanes having the improved Parker check valve, number 1111-577098M1.

(c) Connect air source to ground air connection located in strut. Gain access to ground service connection through access panel 3716 or 1739 located in strut. See Chapter 12, "Access Doors and panels."

NOTE: Supply line between the ground air supply pressure regulator and the ground air connection shall have a minimum inside diameter of 9/32 of an inch.

(3) Check for leakage in pneumatic system.

(a) Check that thrust reverser is in forward thrust position.

(b) Regulate air supply to 60 psig pressure.

(c) Check that there is no apparent leakage (leakage that can be detected by placing a hand on or near a connection) at tube or flexible hose connections.

(d) Regulate air supply to 25 psig.

(e) With forward thrust lever in "IDLE" position actuate reverse thrust lever aft to full reverse thrust position. Verify that forward and aft thrust reversers have moved to reverse thrust position.

(f) Regulate air pressure source to 60 psig.

(g) Check that there is no apparent leakage (leakage that can be detected by placing a hand on or near a connection) at tube or flexible hose connections.

(4) Regulate air pressure source to 25 psig and place the reverse thrust lever in the OFF position. Check that forward and aft thrust reversers have moved to the forward thrust position.

CAUTION: WHEN RETURNING THE THRUST REVERSER TO CRUISE POSITION USING GROUND AIR THE FORWARD THRUST REVERSER SLEEVE MUST BE HELD IN THE AFT POSITION UNTIL ALL THE BLOCKER DOORS HAVE ROTATED TO THE "CRUISE" OR FAIRED POSITION. THIS MAY BE DONE BY USING A RESTRAINT HARNESS, BOEING PART NO. MIT65-10621, OR EQUIVALENT. AS AN ALTERNATE METHOD THE SLEEVE MAY BE RESTRAINED MANUALLY BY A MECHANIC ON EACH SIDE OF THE SLEEVE PUSHING AFT ON THE SLEEVE DURING THE RETRACT CYCLE UNTIL ALL THE BLOCKER DOORS HAVE ROTATED TO THE CRUISE POSITION. THE MECHANICS SHOULD EXERCISE CAUTION TO PLACE THEIR HANDS ON THE SLEEVE IN THE LOWER AREA ADJACENT TO THE FIXED VANE ASSEMBLIES TO PREVENT THEIR HANDS BEING HIT BY THE ROTATING BLOCKER DOORS.

(5) Apply d-c power to bus and engage applicable thrust reverser circuit breaker on radio and TR circuit breaker panel (P5).

(6) Check that the thrust reverser warning light on the pilot's instrument panel is off.

(7) Actuate reverse thrust lever aft to either the interlock or the full reverse thrust position.

(8) Check that the forward thrust reverser and the aft thrust reverser sleeve move to reverse thrust position. The applicable thrust reverser warning light should come on immediately after both of the reverser sleeves leave the forward sealed position. Disengage the circuit breaker. The light shall go off. Re-engage the circuit breaker.

(9) Actuate reverse thrust lever forward to the "IDLE" position.

CAUTION: APPLY RESTRAINT TO FORWARD REVERSER SLEEVE PRIOR TO APPLICATION OF PRESSURE. SEE STEP (4).

(10) Check that the clamshell doors go to full forward thrust position and are firmly seated in the seals. The thrust reverser warning light shall go off.

(11) Remove air pressure from system.

(12) Move forward thrust lever fully aft to "IDLE" position.

(13) Place friction brake handle in full aft position.

(14) Actuate reverse thrust lever aft against a stop position (interlock position).

(15) Apply 50 pound load to reverse thrust lever knob centerline in aft direction. Check that follow-up lock (forward and aft reverser locking cams) resists this load.

(16) Regulate air supply to 25 psig and verify that the forward and aft thrust reverser move to reverse thrust position.

(17) Remove air pressure from system.

(18) Return reverse thrust lever to the "OFF" position.

(19) Actuate forward thrust lever forward against a stop position (interlock position).

(20) Apply a 50 pound load to the forward thrust lever in the forward direction. Check that follow-up lock (fan and aft reverser locking cams) resists this load.

(21) Perform the following check on airplanes having interlock override provisions (VH-EBL and on):

(a) With air pressure off, manually push the aft sleeve only to "cruise" position.

(b) Actuate forward thrust lever forward against the first stop position which is at approximately 12° from the IDLE position.

(c) Apply a 15 pound load to this lever in the forward direction. The follow-up lock shall resist the load.

(d) Apply a 25 pound load to this lever in the forward direction. The lever shall rotate a minimum of 45° from the idle position before the second stop is contacted.

(22) Regulate air pressure to 25 psig. Clamshell doors shall return to forward thrust position, and thrust reverser warning light shall go out.

CAUTION: APPLY RESTRAINT TO FORWARD REVERSER SLEEVE PRIOR TO APPLICATION OF PRESSURE. SEE STEP (4).

(23) Remove air pressure from system.

(24) Remove test equipment and recap ground service connection. Replace access panel.

(25) Reconnect thrust reverser air supply flex hose.

(26) Replace engine side cowl panels and fan cowl panels.

(27) Remove placard from control stand.

(28) Reset friction brake handle.

REVERSE THRUST CONTROLS - MAINTENANCE PRACTICES

1. Unit Servicing Reverse Thrust Controls

A. Lubricate Reverse Thrust Controls (Relubrication of bearings containing MIL-G-25013C Extreme Hi Temperature Grease)

(1) Seizure and binding of the strut and engine mounted control bearings is generally caused by evaporation of the oil in the extreme hi temperature grease (blue-purple colored) with which the bearings are lubricated. Periodically replenishing the silicone fluid in the bearings will rejuvenate the grease and eliminate the necessity of replacing or repacking the bearings. (See figure 201.) For lubrication of throttle system bearings see Chapter 76.

2. Removal/Installation Reverse Thrust Controls

A. Remove Reverse Thrust Controls

(1) Remove thrust reverser directional control valve. (See figure 202.)

(a) Remove engine side cowl panels.

(b) Disconnect pneumatic tubing from directional control valve fittings.

(c) Disconnect valve control links (7, view 1) at valve rod end by removing nut, bolt and cotter pin.

(d) Remove two bolts (8, detail A) attaching control valve to engine controls strut bracket.

(e) Remove valve from engine, being careful not to damage valve or tubing.

(2) Remove thrust reverser directional control valve actuating cam. (See view 1, figure 202.)

(a) Remove engine side cowl panels.

(b) Deleted.

(c) Remove throttle shaft plug (5).

INDEX NO.	ITEM TO BE LUBRICATED	INSTRUCTIONS
1	FOLLOW-UP SHAFT BEARINGS	Apply fluid ▷ to bearings. (4 places each strut)
2	ROD END BEARINGS	Apply fluid ▷ to bearings. (2 places each strut)
3	ROCKER ARM ROLLERS	Apply fluid ▷ (2 places each strut)
4	ROCKER ARM SHAFT BEARINGS	Apply fluid ▷ to bearings. (2 places each strut)
5.	ROCKER ARM BEARING	Apply fluid ▷ to bearing. (1 place each strut)
6	VALVE ACTUATING CAM BEARINGS	Apply fluid ▷ to bearings. (4 places each cam, except 2 places on 65-27438 cams)

▷ Silicone fluid, Dow Corning 550 or Silicone fluid, Dow Corning 510; -100, -500 or -1000 Centistoke. Source: Dow Corning Chemical Company; Midland, Michigan.

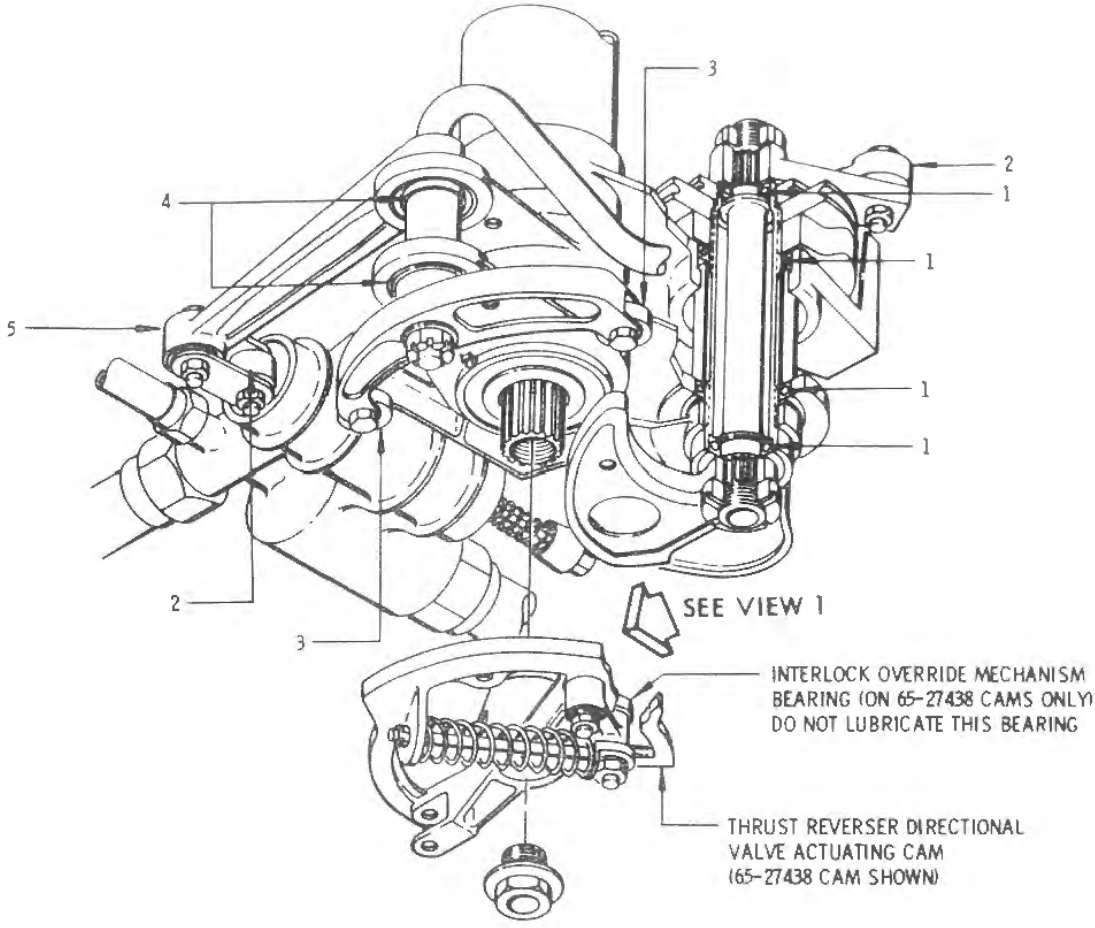
NOTE: The presence of the seals on the bearings may not allow the fluid to readily enter the bearing; therefore, thinning the fluid with a highly volatile solvent will aid getting the fluid into the bearing. If thinning the fluid is desired, it may be thinned in the following proportions with DuPont Freon TE or Freon TA solvent (Source: E.I. DuPont de Nemours, Inc.; Wilmington, Delaware).

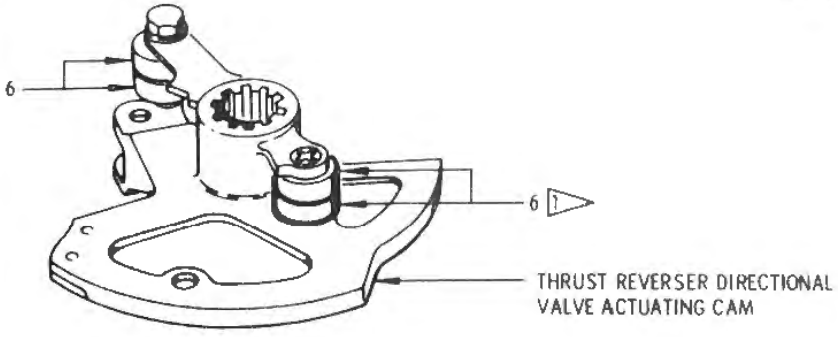
Two parts Dow Corning 550 to one part solvent.
Two parts Dow Corning 510-100 Centistoke to one part solvent.
One part Dow Corning 510-500 Centistoke to one part solvent.
One part Dow Corning 510-1000 Centistoke to two parts solvent.

(d) Disconnect upper thrust rod power setting from directional valve actuating cam.

(e) Slide directional control valve actuating cam off shaft.

NOTE: On some installations it may be necessary to derig throttle control cables and rotate control shaft to obtain sufficient clearance between engine and cam to remove cam from end of shaft. Rerig cables according to instructions in Chapter 76, "Engine Controls" after installing new cam.

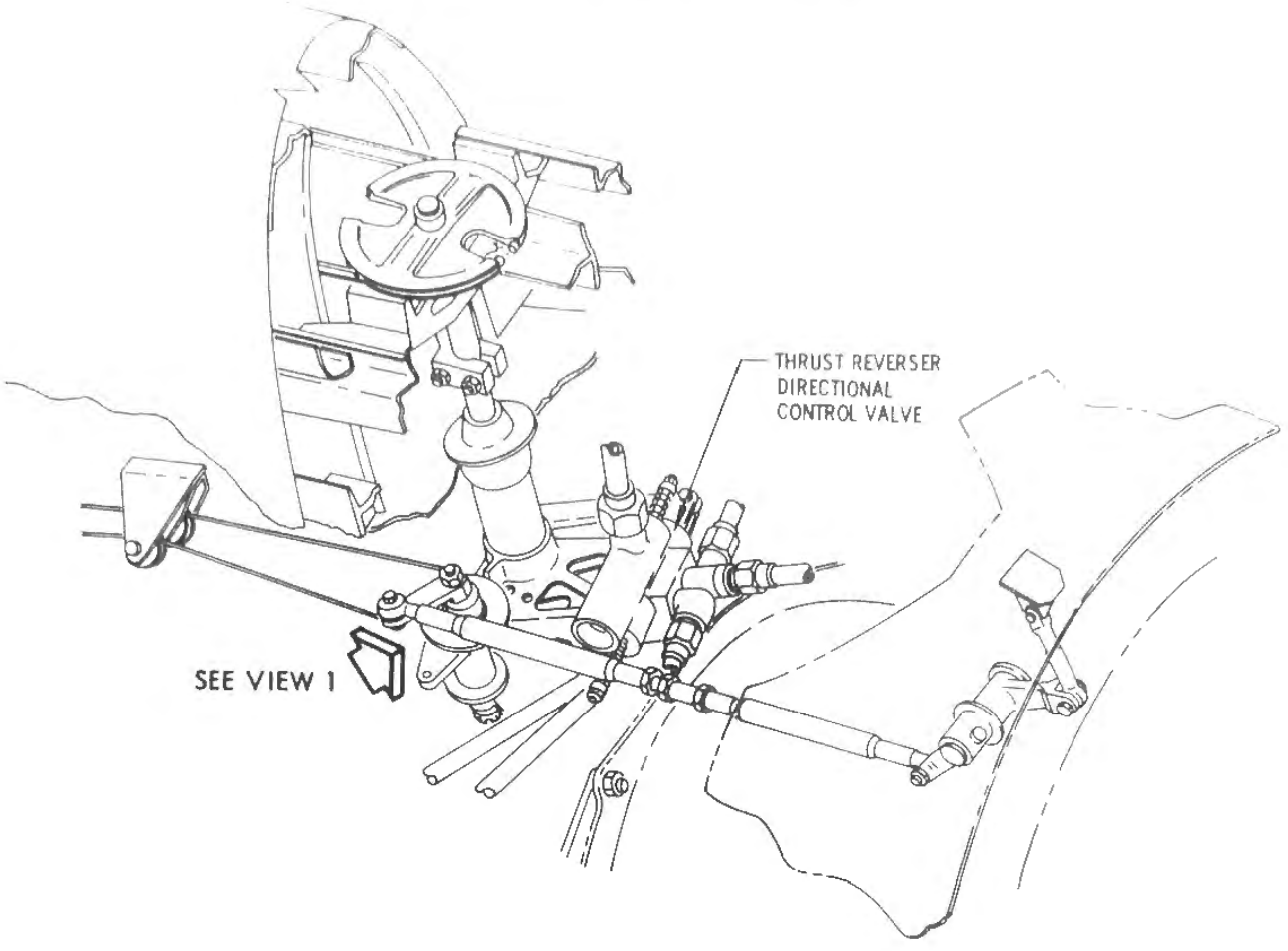


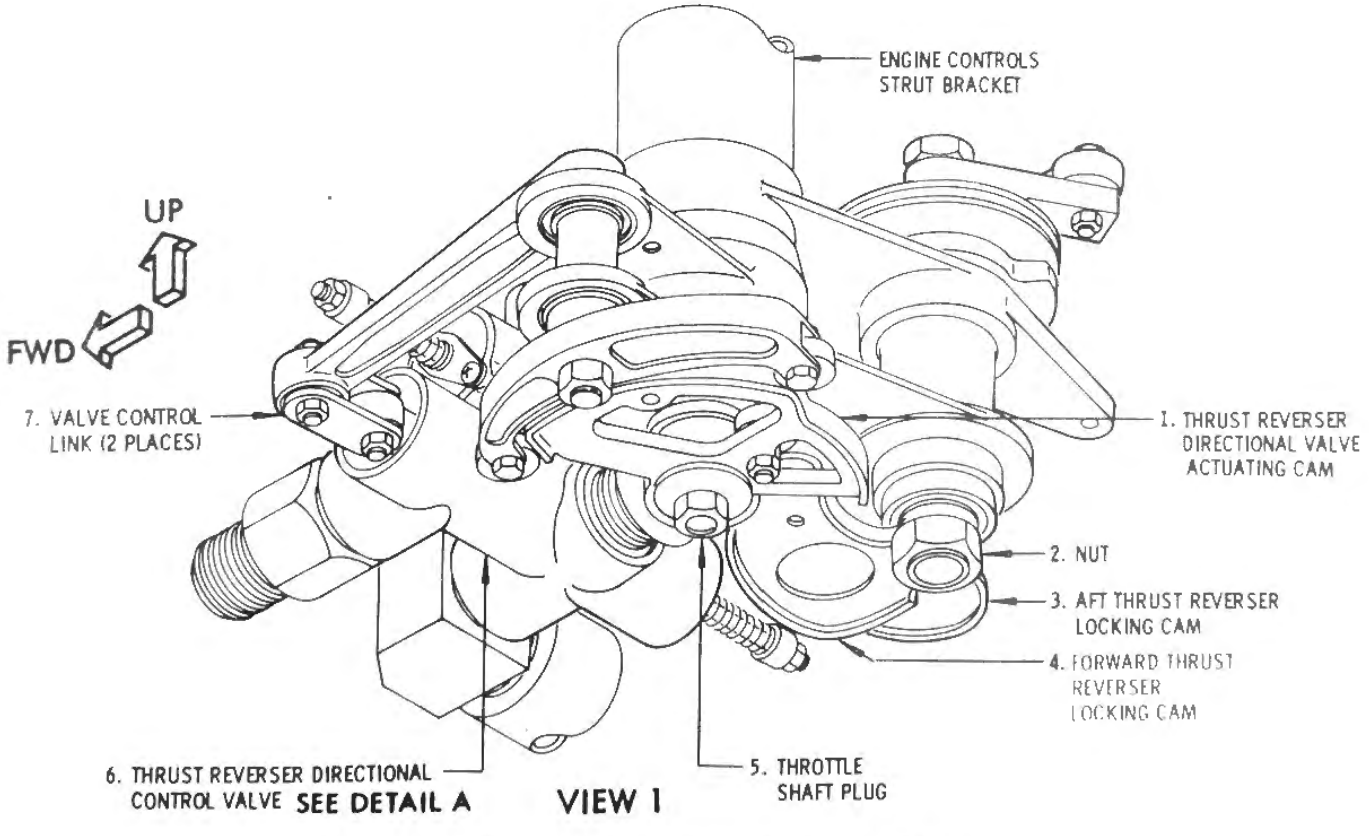


VIEW 1

1 THESE BEARINGS ARE NOT INSTALLED ON CAMS HAVING INTERLOCK OVERRIDE MECHANISM (65-27438 CAMS)

Reverse Thrust Controls Lubrication
Figure 201 (Sheet 2)





Reverse Thrust Controls Installation
Figure 202 (Sheet 1 of 2)

(3) Remove Thrust Reverser Locking Cams

(a) Remove engine side cowl panels.

(b) Remove nut (2, figure 201) retaining forward and aft thrust reverser locking cams on shafts through engine controls strut bracket.

(c) Slide forward thrust reverser locking cam off inner shaft.

(d) Slide aft thrust reverser locking cam off outer shaft.

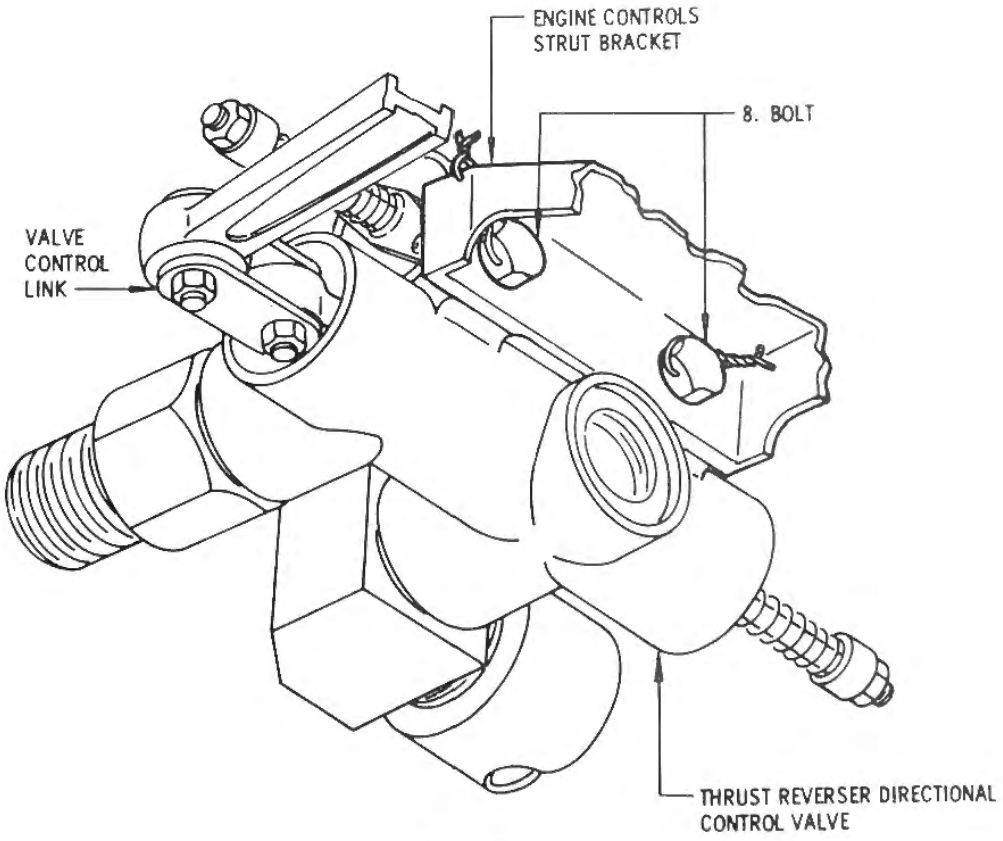
B. Install Reverse Thrust Controls

(1) Install Thrust Reverser Directional Control Valve. (See figure 201.)

(a) Place forward thrust lever in control cab to forward thrust idle position.

(b) Position directional control valve at engine controls strut bracket and attach with bolts (8) and washers. Lockwire. (See detail A.)

(c) With valve control links (7, view 1) attached to valve control arm, attach valve control links to valve rod end with bolt, nut and cotter pin.



DETAIL A

Reverse Thrust Controls Installation
Figure 202 (Sheet 2 of 2)

(d) Connect pneumatic tubing to directional valve. On installations using 69-10700-2 directional valve, do not exceed 350 to 400 pound-inches torque on the coupling nuts when connecting the two 1/2-inch pneumatic lines.

CAUTION: DAMAGE TO THE 1/2-INCH FITTINGS ON THE 69-10700-2 VALVE MAY RESULT IF THIS TORQUE LIMIT IS EXCEEDED.

(2) Install Thrust Reverser Directional Valve Actuating Cam

(a) Line up spline indices on directional valve actuating cam and throttle control shaft and slide cam onto shaft. Check that rigging pin hole in cam lines up with rigging pin hole in engine controls strut bracket.

(b) Install throttle shaft plug (5, view 1) and cotter pin on lower end of throttle shaft and tighten within torque range of 290-410 pound-inches. Maximum torque allowed for installation of cotter pin is 660 pound-inches. Lockwire.

(c) Connect upper thrust rod to directional valve actuating cam.

(d) Check adjustment of thrust system. See Chapter 76, "Engine Controls."

(3) Install Thrust Reverser Locking Cams

(a) Line up spline indices on aft thrust reverser locking cam and outer shaft of the two follow-up control shafts through the engine controls strut bracket and insert cam on shaft.

(b) Line up spline indices on forward thrust reverser locking cam and inner shaft and insert cam on shaft.

(c) Install nut (2) and cotter pin. Tighten nut within torque range of 290-410 pound-inches. Maximum torque allowable for insertion of cotter pin is 660 pound-inches.

FORWARD THRUST REVERSER FOLLOW-UP LINKAGE - MAINTENANCE PRACTICES

1. Removal/Installation Forward Thrust Reverser Follow-Up Linkage

A. Remove Forward Thrust Reverser Follow-Up Linkage

(1) Remove engine side cowl panels.

(2) Place thrust reverser in forward thrust position.

(3) Disconnect follow-up rod (2, figure 201) from forward thrust reverser follow-up crank (6).

(4) Remove follow-up crank (6) by removing nut (3) attaching crank to shaft.

(5) Disconnect follow-up rod (2) from follow-up linkage arm (7) at linkage support bracket (8) on power plant diaphragm at upper vertical centerline of engine.

(6) Disconnect follow-up rod (9) from bracket (10) at inner surface of cowl ring at upper vertical centerline.

(7) Remove follow-up linkage mounted on shaft through bracket (8) by removing bracket. Remove 4 bolts on each side attaching bracket to power plant fan air exhaust diaphragm. Follow-up rod (9) is removed with bracket linkage.

B. Install Forward Thrust Reverser Follow-Up Linkage

(1) Place thrust reverser in forward thrust position.

(2) Install linkage support bracket (8, figure 201) including shaft mounted linkage and follow-up rod (9) to power plant fan air exhaust diaphragm at mounting location at upper vertical centerline of diaphragm with 8 bracket attachment bolts. Add or remove laminated shims between bracket and bolt heads as required.

(3) Connect follow-up rod (9) to bracket (10) on underside of cowl ring upper surface with nut, bolt, washer, and cotter pin. Install bolt from left side as shown in figure 201.

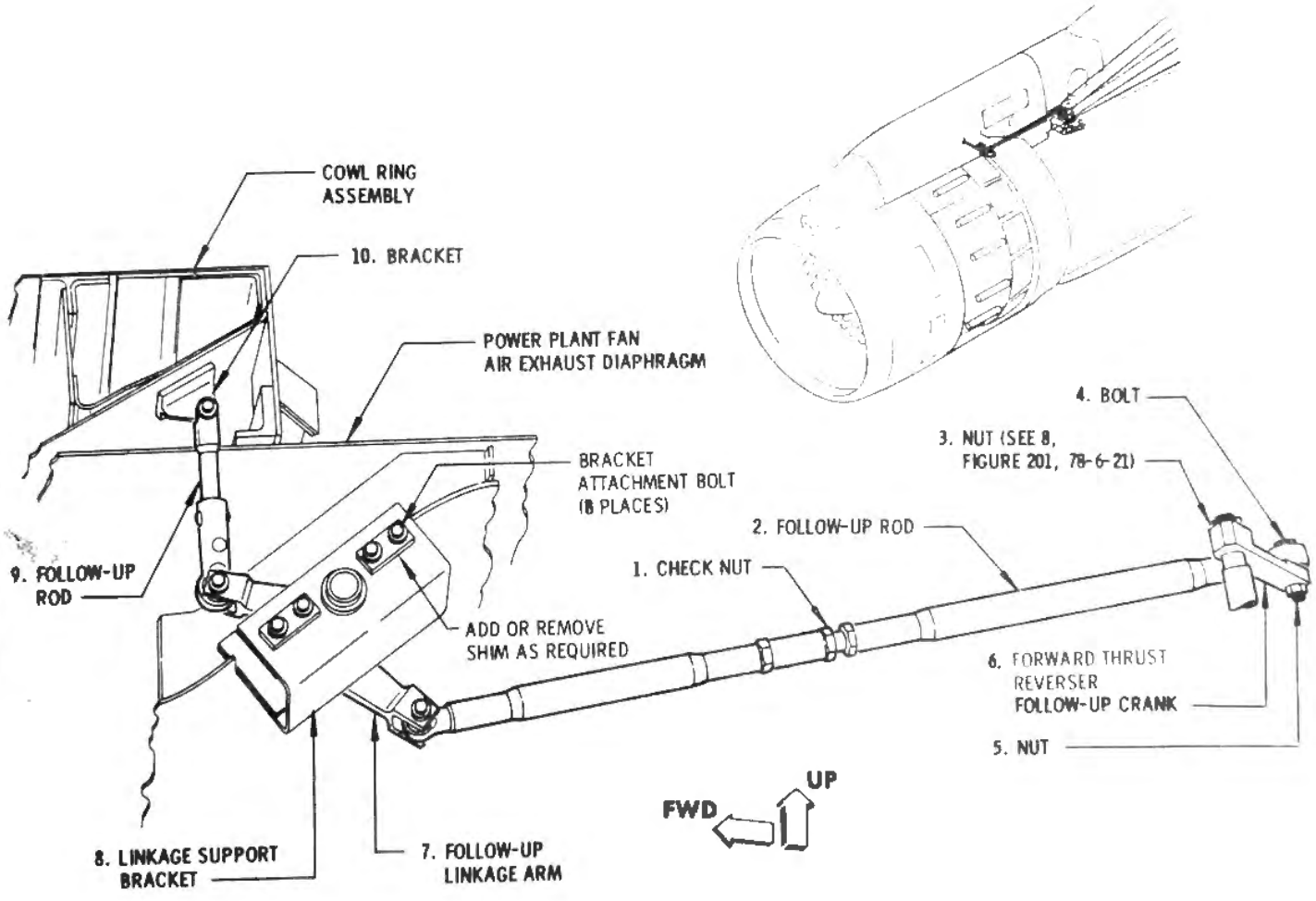
(4) Install follow-up crank (6) on shaft through engine controls strut bracket. Secure crank to shaft with nut (3).

(5) Connect follow-up rod (2) to linkage arm (7) on bracket mounted linkage with bolt, nut, washer and cotter pin. Insert bolt from right side. See figure 201 to determine correct end of rod to connect to linkage arm (7).

(6) Connect the other end of follow-up rod (2) to upper surface of follow-up crank (6).

(a) Insert rigging pin through rigging pin holes in forward and aft thrust reverser locking cams, and engine controls strut bracket.

(b) Position end of follow-up rod (2) over installation hole in end of follow-up crank and insert bolt (4), with washer, shank down, through rod end and follow-up crank. If bolt cannot be inserted freely, adjust length of follow-up rod until bolt can be inserted freely. Loosen check nut (1) in center of rod assembly to make adjustments. Tighten check nut following adjustment.



Forward Thrust Reverser Follow-Up Linkage Installation
Figure 201

(c) Install washer and nut (5).

(7) On inside surfaces of bracket, apply fillet sealing compound, Pro-Seal 567 (Coast Pro-Seal and Manufacturing Co, Los Angeles, Cal.) or equivalent, around joining edge of bracket and diaphragm structure. Do not seal drain hole in bracket.

(8) Remove rigging pin.

2. Adjustment/Test Forward Thrust Reverser Follow-Up Linkage

A. Rig Forward Thrust Reverser Follow-Up Linkage

(1) Place forward thrust reverser in full forward thrust position (against forward stops).

(2) Adjust length of follow-up rod assembly (2) until rigging pin can be inserted easily through rigging pin holes through engine controls strut bracket, aft thrust reverser locking cam, and forward thrust reverser locking cam.

NOTE: Aft thrust reverser follow-up linkage rigging should be checked prior to performing this rigging. (Refer to 78-6-21.)

AFT THRUST REVERSER FOLLOW-UP LINKAGE - MAINTENANCE PRACTICES

1. Removal/Installation Aft Thrust Reverser Follow-Up Linkage

A. General

(1) The aft thrust reverser follow-up pulley, the aft thrust reverser drum-and-crank and yoke assembly, and the miscellaneous linkages (control rods and idler arms) may be removed separately. When any miscellaneous linkages are removed, perform rigging according to instructions in paragraph 2.B.

(2) If replacing idler link (figure 201) the torque on the bolt attaching idler link to actuator support link should be limited to 15 to 25 pound-inches, to prevent bushing seizure.

B. Equipment and Materials

(1) Spring scale - 0 to 250 pounds

(2) Rigging pin MS20392 or 0.312 (+0.000/-0.003) diameter pin

(3) Spanner wrench - F71435-4 or equivalent (F71435-4 is part of engine control wrench kit - F71435.)

C. Remove Aft Thrust Reverser Follow-Up Linkage

(1) Remove aft thrust reverser follow-up pulley. (See figure 201.)

(a) Remove cotter pin, nut, washers and bolt attaching forward thrust reverser follow-up rod to forward thrust reverser follow-up crank (9).

(b) Remove nut (10) securing follow-up crank to shaft through engine controls strut bracket.

(c) Remove forward thrust reverser follow-up crank from shaft.

(d) Remove lockring (15) from nut (14). Remove nut (14) using spanner wrench.

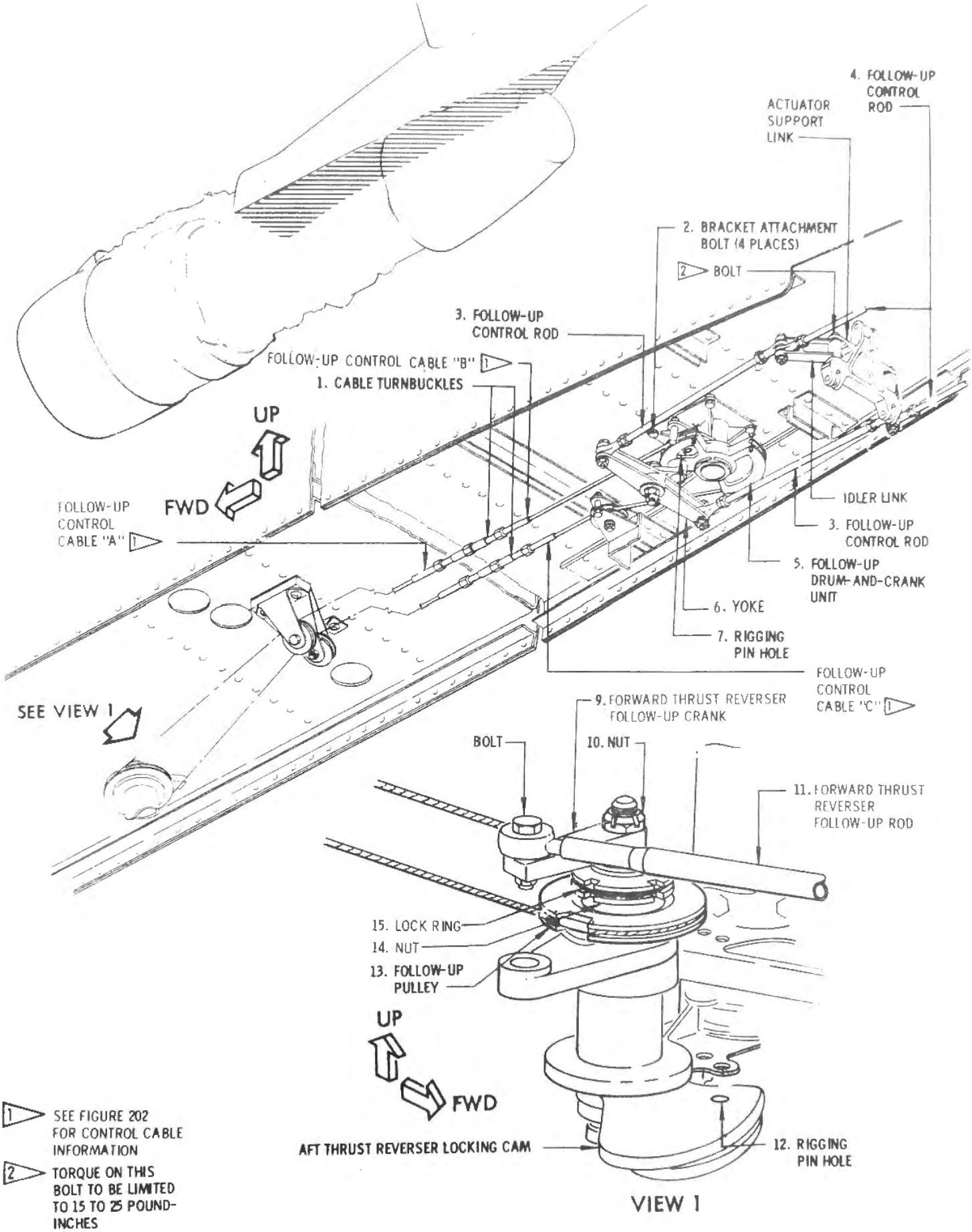
(e) Loosen cable turnbuckles (1) and remove cables from aft thrust reverser follow-up pulley (13).

(f) Remove follow-up pulley from shaft.

(2) Remove follow-up drum-and-crank and yoke.

(a) Loosen cable turnbuckles and remove cables from follow-up drum-and-crank unit (5, figure 201).

(b) Disconnect two follow-up control rods (3) at yoke (6) attachment.



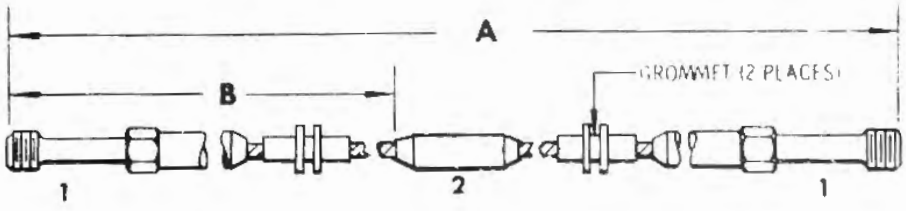
1 SEE FIGURE 202 FOR CONTROL CABLE INFORMATION

2 TORQUE ON THIS BOLT TO BE LIMITED TO 15 TO 25 POUND-INCHES

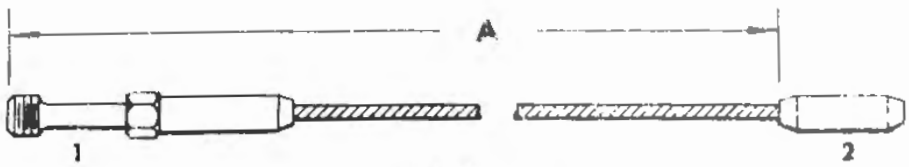
Aft Thrust Reverser Follow-Up Linkage
Figure 201

CABLE REF (1)	DRAWING NO.	NO. REQ.	CABLE LENGTH A	CABLE LENGTH B	CABLE SIZE	FITTINGS 1	FITTINGS 2
A	63-10189	1	81.30	42.80	1/8 7 X 19	AN669S4RH	BAC-114A-4
B	BAC-C13G-466-267C	1	26.7		1/8 7 X 19	AN669S4LH	BAC-114A-4
C	BAC-C13G-466-225C	1	22.5		1/8 7 X 19	AN669S4LH	BAC-114A-4

(1) SEE FIGURE 201 FOR CABLE LOCATIONS.



CABLE A



CABLES B AND C

Aft. Thrust Reverser Follow-Up Control Cables
Figure 202

QANTAS MANUFACTURER'S PUBLICATION REVISION

BOEING 707 MAINTENANCE MANUAL

QANTAS REVISION NO. 6

General

This revision sheet provides Company instructions and procedures supplementary to or superseding those contained in the above publication.

Action

This revision supersedes Qantas Revision No. 3 which should be removed, and destroyed.
Insert this page adjacent to Chapter 78-6-21, Page 203 and enter details on revision list at the front of the Maintenance Manual.

Authority.

Status Minute No. 19464.

AFT THRUST REVERSER FOLLOW-UP LINKAGE ADJUSTMENT.

Refer to Paragraph D (h).

Where Boeing Service Bulletin 1738 has been incorporated, (identified by installation of caterpillar grommet at fireseal web in lieu of steel grommet) tension cables to 200 ± 20 pounds.

(c) Remove bolts (2) and washers from bracket (4 places) and remove drum-and-crank and yoke from engine.

D. Install Aft Thrust Reverser Follow-Up Linkage

(1) Install aft thrust reverser follow-up pulley (13, figure 201).

(a) Place forward thrust reverser follow-up pulley on follow-up controls shaft through engine controls strut bracket.

(b) Install nut (14, figure 201) over follow-up pulley using spanner wrench. Tighten nut within torque range of 290-410 pound-inches. Install lockring (15). Maximum of 660 pound-inches is allowable for installation of lockring.

(c) Install forward thrust reverser follow-up crank (9) on shaft.

(d) Install nut (10) securing follow-up crank to shaft through engine controls strut bracket. Tighten nut within torque range of 290-410 pound-inches. Maximum of 660 pound-inches is allowable for installation of cotter pin.

(e) Attach control cables to follow-up pulley (13).

(f) Insert rigging pin through rigging pin hole (7) in follow-up drum-and-crank unit (5) and drum support bracket.

(g) Place forward thrust lever in full forward thrust position and insert rigging pin through rigging pin hole (12) in aft thrust reverser locking cam and engine controls strut bracket.

(h) On airplanes VH-EBA thru VH-EBK adjust turnbuckles (1) until rigging pin is easily inserted with a cable tension of 50 (± 5) pounds. On airplanes VH-EBL and on, adjust turnbuckles (1) until rigging pin is easily inserted with a cable tension of 200 to 230 pounds.

(i) Remove rigging pins.

(j) Attach forward thrust reverser follow-up rod to forward thrust reverser follow-up crank with nut, bolt and washer. Rig forward thrust reverser follow-up linkage. See 78-6-11, "Rig Forward Thrust Reverser Follow-Up Linkage."

(2) Install follow-up drum-and-crank and yoke.

(a) Position bracket with follow-up drum-and-crank and yoke attached and install bracket with washers and mounting bolts (2).

(b) Connect cables to drum-and-crank unit (5).

(c) Insert rigging pin through rigging pin holes (7) in drum-and-crank unit and bracket.

(d) Place forward thrust lever in full forward thrust position and insert rigging pin through aft thrust reverser locking cam and engine controls strut bracket.

(e) On airplanes VH-EBA thru VH-EBK adjust turnbuckles (1) until rigging pin is easily inserted with a cable tension of 50 (± 5) pounds. On airplanes VH-EBL and on, adjust turnbuckles (1) until rigging pin is easily inserted with a cable tension of 200 to 230 pounds.

(f) Remove rigging pin from aft thrust reverser locking cam and engine controls strut bracket, but leave rigging pin through follow-up drum-and-crank unit (5) and bracket in place.

(g) Check that correct vertical clearance exists between sleeve and strut skin and adjust if necessary. Refer to 78-5-61, "Adjustment/Test Aft Thrust Reverser."

(h) Position thrust reverser sleeve against forward stop.

(i) Adjust length of two follow-up control rods (3) such that holes in rod ends align freely with holes in yoke (6) while maintaining yoke in correct horizontal alignment.

NOTE: The length of follow-up control rods (4) is not to be adjusted during rigging. The length of these rods should be the original installed length of 9.76 inches.

(j) Install bolts with nuts and cotter pins through rod ends and yoke.

(k) Remove rigging pin from rigging pin hole (7).

2. Adjustment/Test Aft Thrust Reverser Follow-Up Linkage

A. General

(1) The aft thrust reverser follow-up linkage is rigged with the thrust reverser in the forward position and with the engine at ambient (atmospheric) temperature.

B. Equipment and Materials

(1) Rigging pin MS20392 or 0.312 (0.000/-0.003) diameter pin

C. Adjust Aft Thrust Reverser Follow-Up Linkage

(1) Insert rigging pin (7, figure 201) in follow-up drum-and-crank unit (5, figure 201) and follow-up drum support bracket.

(2) Place forward thrust lever in full forward thrust position and insert rigging pin (12) through aft thrust reverser locking cam and engine controls strut bracket.

(3) On airplanes VH-EBA thru VH-EBK, adjust turnbuckles (1) until rigging pin is easily inserted with a cable tension of 50 (± 5) pounds. On airplanes VH-EBL and on, adjust turnbuckles (1) until rigging pin is easily inserted with a cable tension of 200 to 230 pounds.

(4) Remove rigging pins.

(5) Prepare to rig aft thrust reverser follow-up linkage from follow-up drum to aft thrust reverser hinge drive mechanism.

(a) For this rigging it is necessary that the aft thrust reverser sleeve stop be adjusted to give correct clearance between sleeve and strut skin. Refer to 78-5-61, "Adjustment/Test Aft Thrust Reverser."

(6) Position thrust reverser sleeve against forward stop.

(7) Remove bolt from end of both follow-up control rods (3) at yoke (6) connection.

(8) With forward thrust lever maintained in the forward thrust position, install rigging pin through follow-up drum-and-crank unit (5) and follow-up drum support bracket.

(9) Adjust length of control rods (3) such that bolts removed in step (7) can be installed freely while maintaining yoke horizontally aligned.

NOTE: The length of follow-up control rods (4) is not to be adjusted during rigging. The length of these rods should be the original installed length of 9.76 inches.

(10) Install nuts and cotter pins.

(11) Remove rigging pin.

FORWARD THRUST REVERSER ACTUATORS - MAINTENANCE PRACTICES

1. Removal/Installation Forward Thrust Reverser Actuators

A. General

(1) When installing the forward thrust reverser blocker door actuators it is necessary to align the actuators properly. Proper alignment constitutes alignment of the rod end bearing with the clevis of the blocker door.

B. Install Forward Thrust Reverser Blocker Door Actuator (Applicable to installations using actuators 65-10649-4 and 65-10649-9)

(1) Manually position cowl ring and blocker door into reverse thrust position.

(2) Position actuator at mounting bracket attachment bosses on engine and extend actuator piston rod into reverse thrust position. (See figure 201.)

(3) Add washers between actuator support bracket mounting bosses and bearings at actuator attachments until actuator rod end bearing is aligned in clevis attachment on blocker door and clearance between support bracket and actuator bearing is reduced to 0.016 inch maximum.

(4) Manually position cowl ring and blocker door in reverse thrust position.

(5) Extend actuator piston rod into reverse thrust position.

NOTE: The forward thrust reverser actuators can be preset for extended length prior to installation on the airplane. The dimension from the rod end bearing centerline to the aft face of the bushing retainer plate with the actuator in the extended (reverse thrust) position is shown in figure 201.

(6) Check alignment by holding actuator at pivot end (forward) and blocker door in maximum reverse thrust position. The rod end bearing must align with clevis of blocker door within 0.010 inch while in its free position.

(7) If blocker door and actuator rod end clevis do not align, use laminated shims between actuator support brackets and engine flange as required. Use a maximum of 3 shims per bracket. Maintain a step of 0.010 inch between adjacent shims.

(8) After proper alignment is achieved in reverse thrust position, check alignment in forward thrust position by moving cowl ring and blocker door to within 3-1/2 inches from forward thrust position. If blocker door can be raised or lowered within tne lateral play of

its rollers to the support tracks to allow the rod end to be inserted in the clevis, the alignment is satisfactory.

(9) If misalignment exists in forward thrust position rearrange washers located at actuator pivot point and shims between support bracket and engine flange.

(10) Check alignment again in reverse thrust and forward thrust positions.

(11) Connect actuator rod end bearing to clevis attachment with nut and bolt.

C. Install Forward Thrust Reverser Blocker Door Actuator (Applicable to installations using actuator 65-20892-5.)

(1) Manually position cowl ring and blocker door into reverse thrust position.

(2) Position actuator on engine with fixed rod bearing end between clevis flanges of engine mounting bracket. Attach with bolt, nut, washer, and cotter pin. Install washer under bolt head. Torque 20-25 inch-pounds.

(3) Extend actuator piston rod into reverse thrust position.

NOTE: The forward thrust reverser actuators are preset for extended length prior to installation on the airplane. The dimension from the rod end bearing centerline to the aft face of the bushing retainer plate with the actuator in the extended (reverse thrust) position is shown in figure 201.

(4) Connect actuator piston rod end to blocker door clevis attachment with nut, bolt, and two washers, (one each under bolt head and nut).

D. Install Forward Thrust Reverser Vane Assembly Actuator (Applicable to both 65-10649-5 and 65-20892-6 installations.)

(1) Position vane assembly actuator at actuator support mounting brackets and attach with two bolts. Lockwire.

(2) Manually position cowl ring with vane assembly attached into reverse thrust position.

(3) Position piston rod end (figure 202) between the flanges of the clevis attachment on the forward face of the vane assembly and attach with bolt, nut, and two washers. Install washers between rod end and flange on either side. Tighten nut until snug.

CAUTION: TIGHTEN NUT CAREFULLY SO THAT BOLT HEAD AND NUT ARE JUST SEATED AGAINST THE FLANGES OF THE CLEVIS. OVER-TIGHTENING OF THIS NUT AND BOLT CAN CAUSE BENDING OF THE CLEVIS FLANGES WHICH MAY RESULT IN THEIR FAILURE.

2. Adjustment/Test Forward Thrust Reverser Actuators

A. Adjust Forward Thrust Reverser Blocker Door Actuator Installation (Applicable to installations using actuators 65-10649-4 and 65-10649-9.)

(1) Manually position cowl ring and blocker door into reverse thrust position.

(2) Remove bolt attaching actuator rod end bearing to actuator clevis attachment.

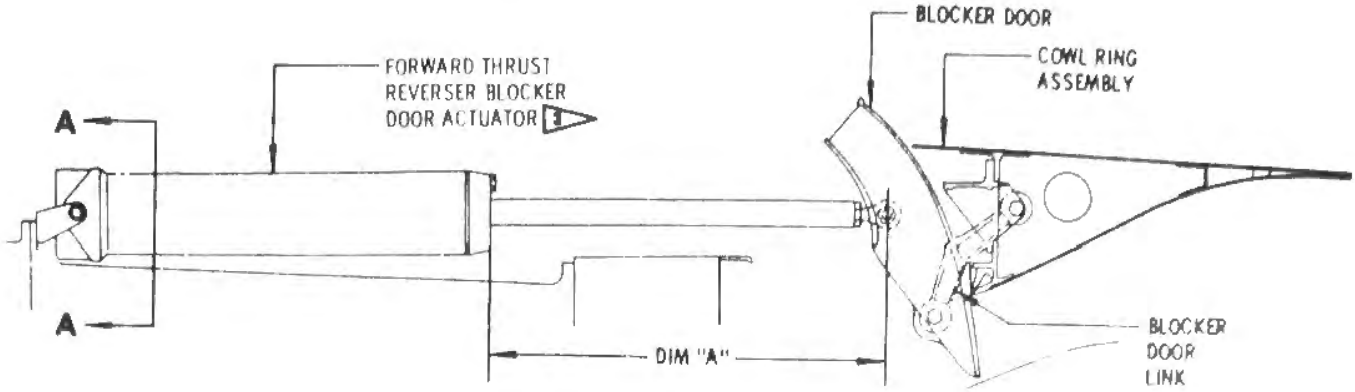
(3) Extend piston rod into reverse thrust position.

NOTE: The forward thrust reverser actuators are preset for extend length prior to installation on the airplane. The dimension from the rod end bearing centerline to the aft face of the bushing retainer plate with the actuator in the extended (reverse thrust) position is shown in detail E.

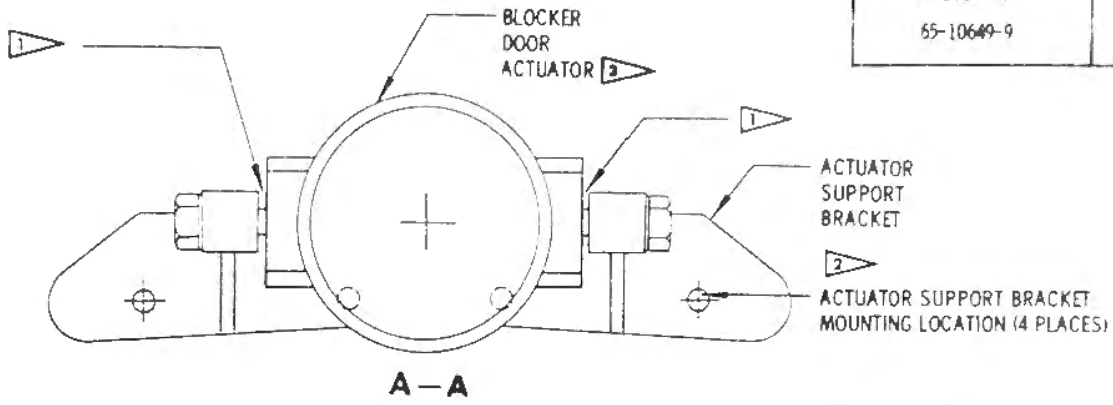
(4) Add washers at pivot end of actuator as required to reduce clearance between support bracket and actuator bearing to 0.016 inch maximum, and to align actuator rod end bearing with clevis of blocker door.

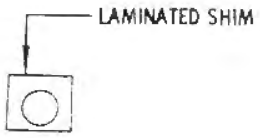
(5) Check actuator alignment by holding actuator at pivot end and holding blocker door in maximum reverse thrust position. The actuator rod end bearing must align with clevis of blocker door within 0.010 inch while in its free position.

(6) When misalignment exists use laminated shims between actuator support bracket and engine flange as required. Use a maximum of 3 shims per bracket. A step of 0.010 inch is allowed between adjacent shims.



ACTUATOR	DIM 'A'
65-10649-4	11.65
65-10649-9	11.43

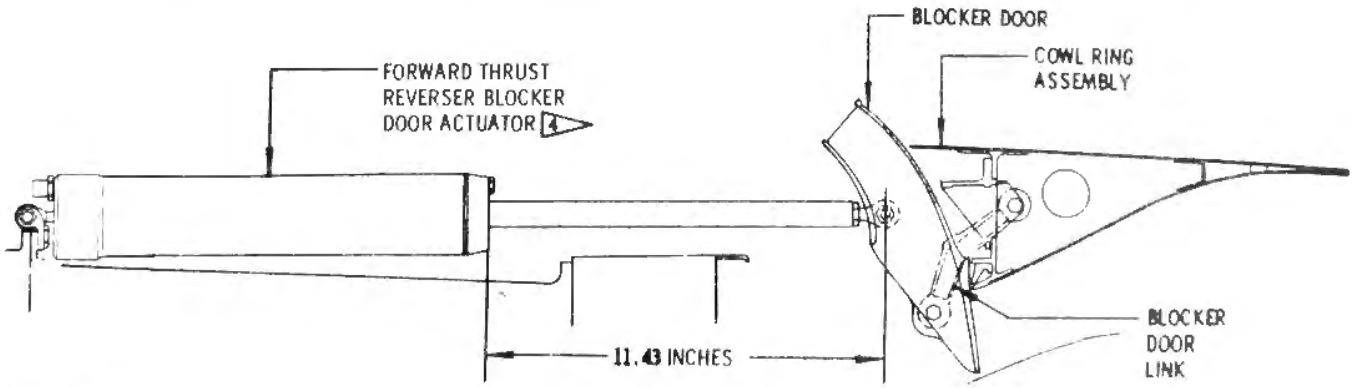




1 ADD WASHERS HERE AS REQUIRED

2 ADD LIMINATED SHIMS AS REQUIRED

3 APPLICABLE ONLY ON INSTALLATIONS USING 64-10649-4 OR 65-10649-9 ACTUATORS

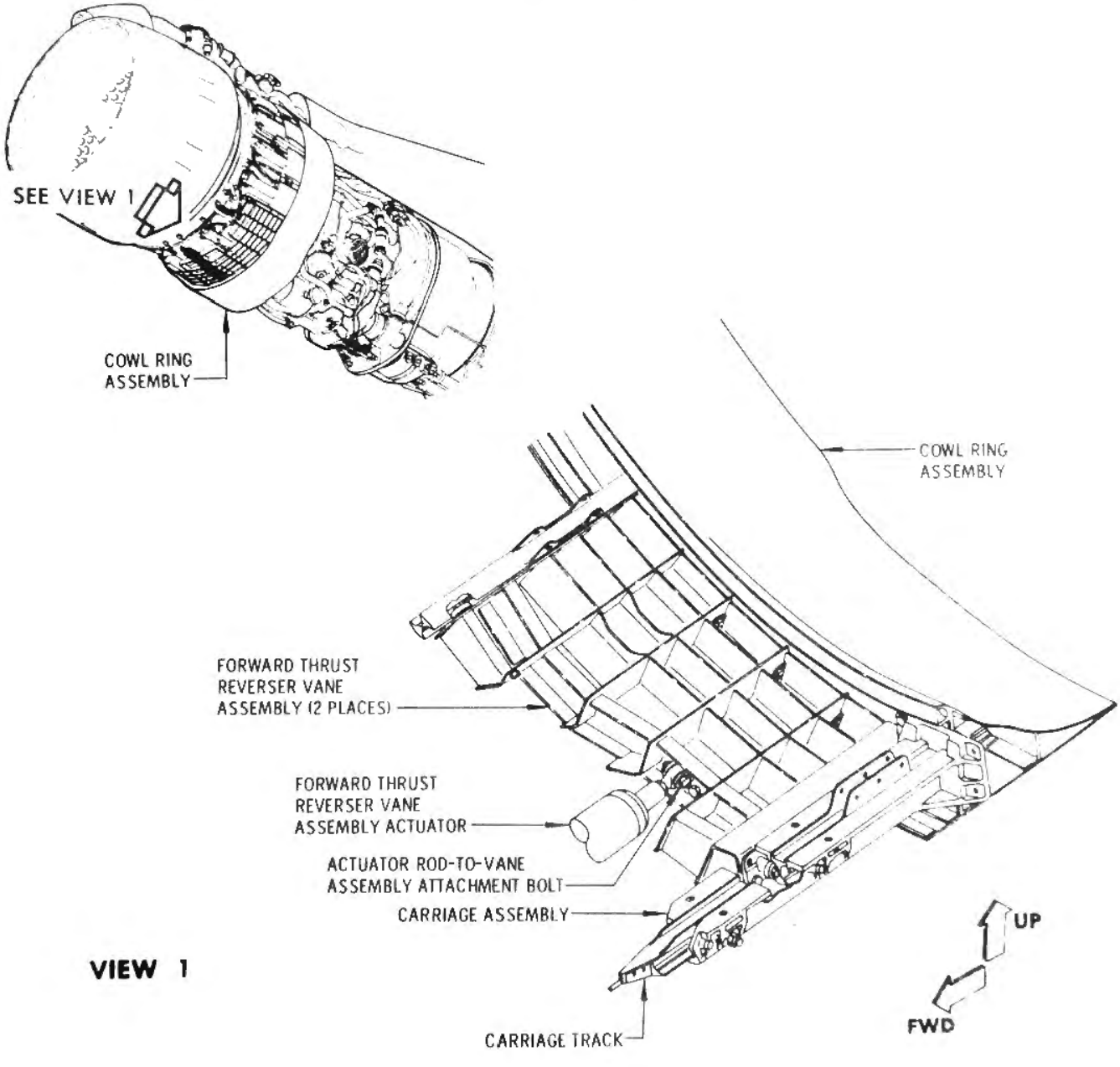


4 65-20892-5 ACTUATOR ONLY

(7) After proper alignment is achieved in reverse thrust position check alignment in forward thrust position by moving cowl ring and blocker door to within 3-1/2 inches from forward thrust position. If blocker door can be raised or lowered within the lateral play of its rollers to the support tracks to allow the rod end to be inserted in the blocker door clevis attachment, the alignment is satisfactory.

B. Adjust Vane Assembly Actuator Installation (Applicable to both 65-10649-5 and 65-20892-6 installations.)

(1) Adjust rod ends on both vane assembly actuators so that actuators do not bottom in either forward or reverse thrust positions. Reconnect piston rod end to vane assembly clevis attachment according to instructions in paragraph 1.C.



Forward Thrust Reverser Vane Assembly Actuator Installation
Figure 202

AFT THRUST REVERSER ACTUATORS - MAINTENANCE PRACTICES

1. General

A. The time involved in removing the upper actuator assembly is greater than for the lower actuator assembly. If one of the upper actuator cylinders is damaged, an alternative to replacing the complete upper actuator assembly would be to deactivate the damaged actuating cylinder by disconnecting the cylinder rod end and capping the air source according to the procedure in paragraph 3 below. It is not allowable to deactivate a complete actuator, top or bottom. Only one cylinder of the four in both actuator assemblies may be rendered inoperative. When an actuating cylinder is deactivated, appropriate provision should be made to insure that the complete actuator is changed at the first layover where time and parts are available.

2. Removal/Installation Aft Thrust Reverser Actuators

A. Equipment and Materials

(1) Anti-seize compound - Ease-off 990 (Texacone Company, Dallas 8, Texas) or equivalent

B. Remove Aft Thrust Reverser Actuators (See figure 201.)

(1) Remove aft thrust reverser lower actuator assembly. (See view 1, figure 201.)

(a) Disconnect pneumatic tubing.

(b) Manually actuate upper and lower sleeve locks and slide sleeve slightly aft so that locks remain disengaged.

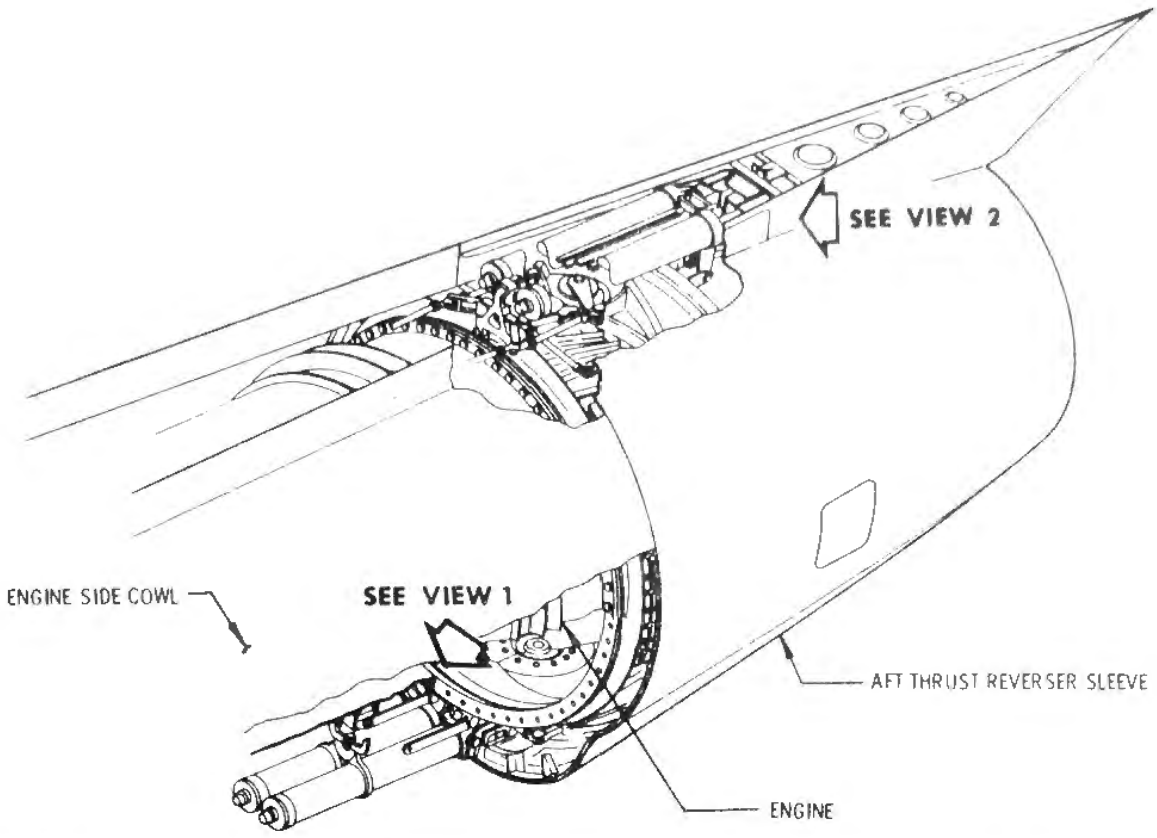
(c) Remove sleeve lower track to actuator assembly attachment bolt.

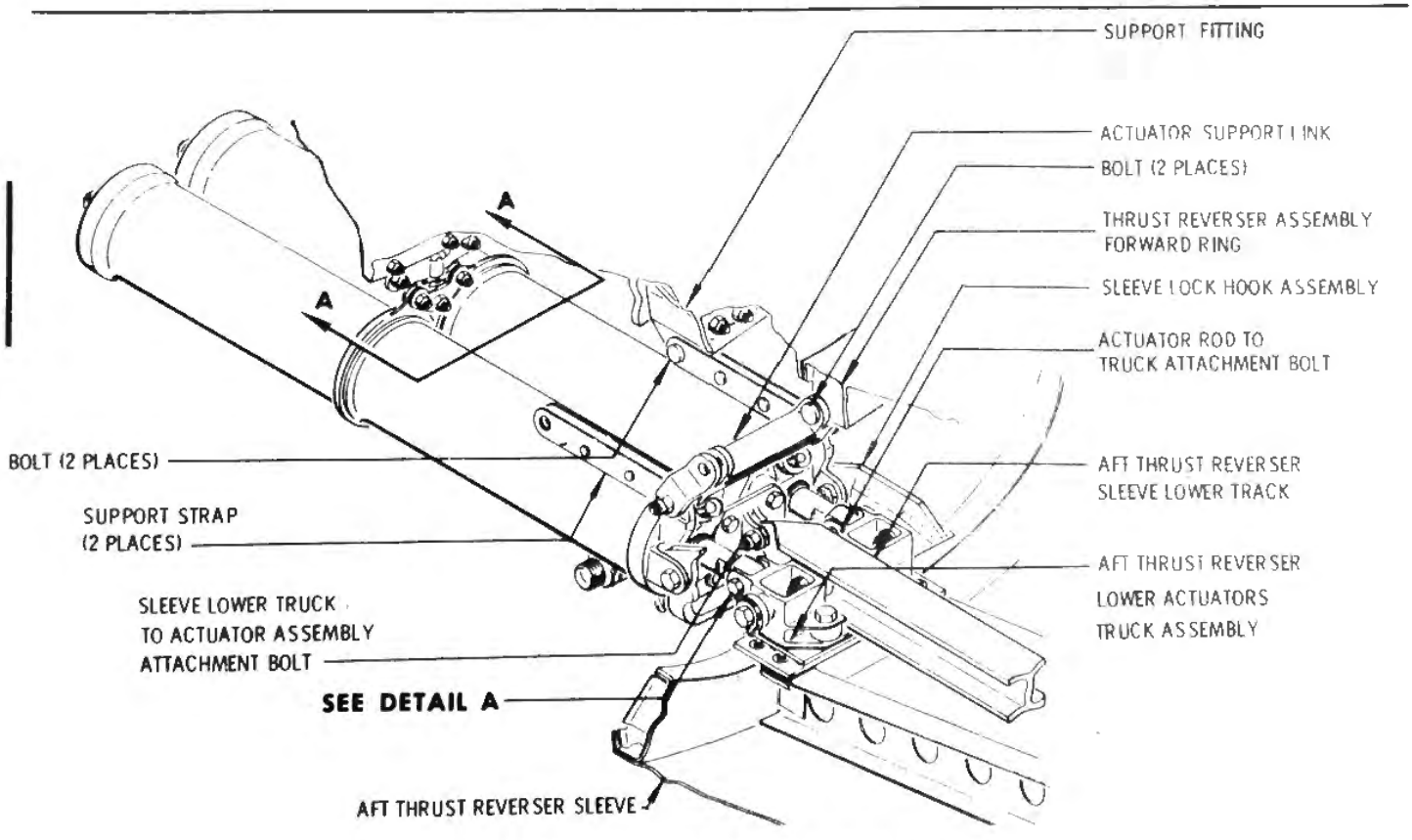
(d) Remove actuator rod to truck attachment bolts.

(e) Remove bolts attaching lower actuator support link to thrust reverser assembly forward ring.

(f) Remove bolts attaching support strap to support fitting.

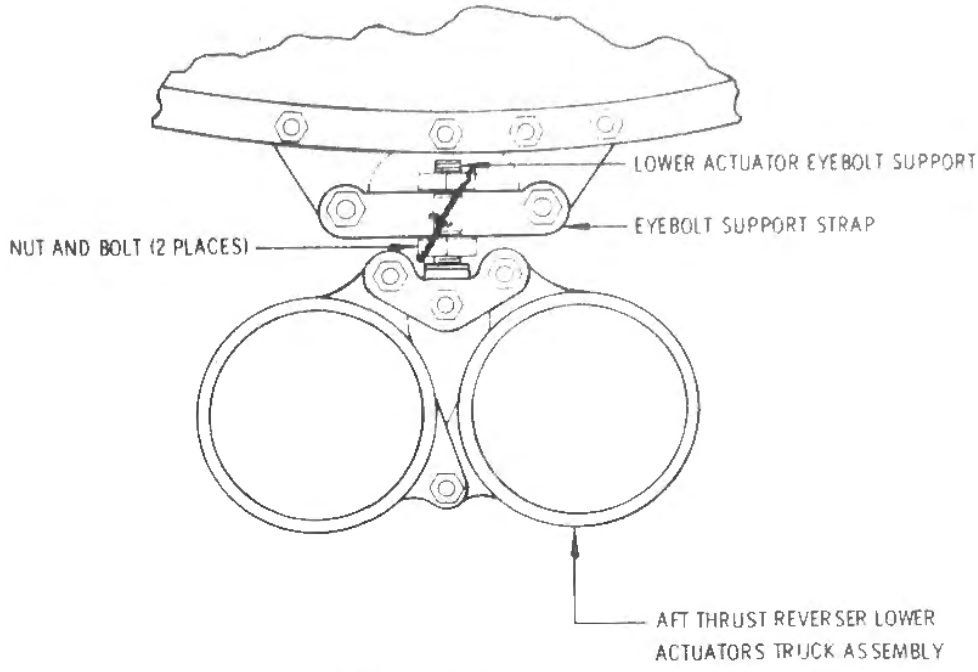
(g) On airplanes having lower actuator support as shown in section A-A, configuration 1, support actuators manually and remove two bolts at lower actuator eyebolt support connection to free actuator assembly from engine.



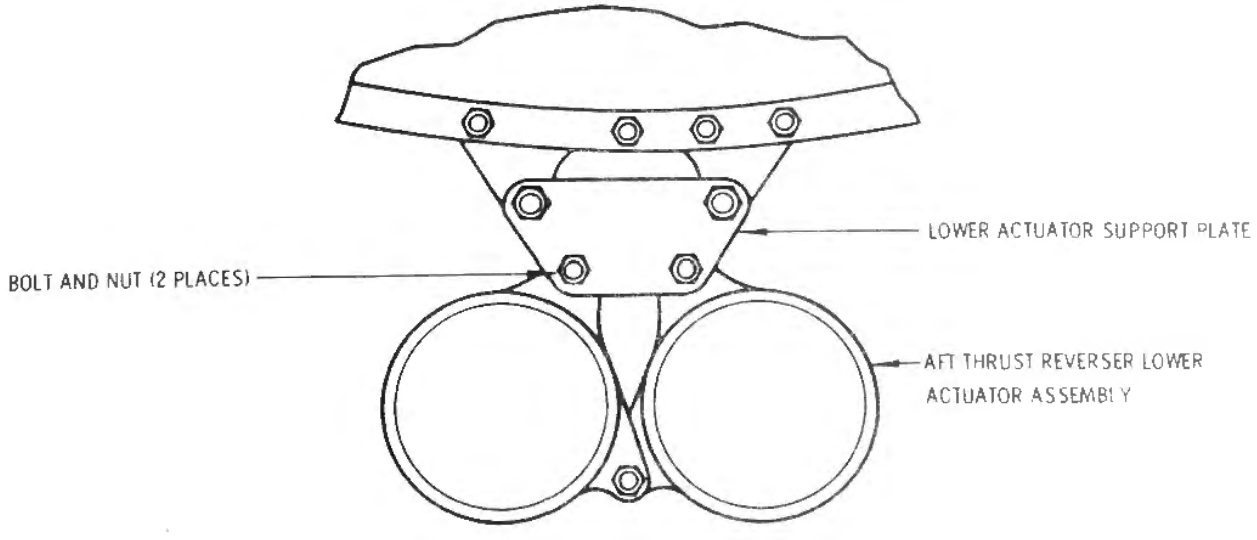


LOWER ACTUATORS ASSEMBLY
VIEW 1

Aft Thrust Reverser Actuators Installation
Figure 201 (Sheet 1 of 3)

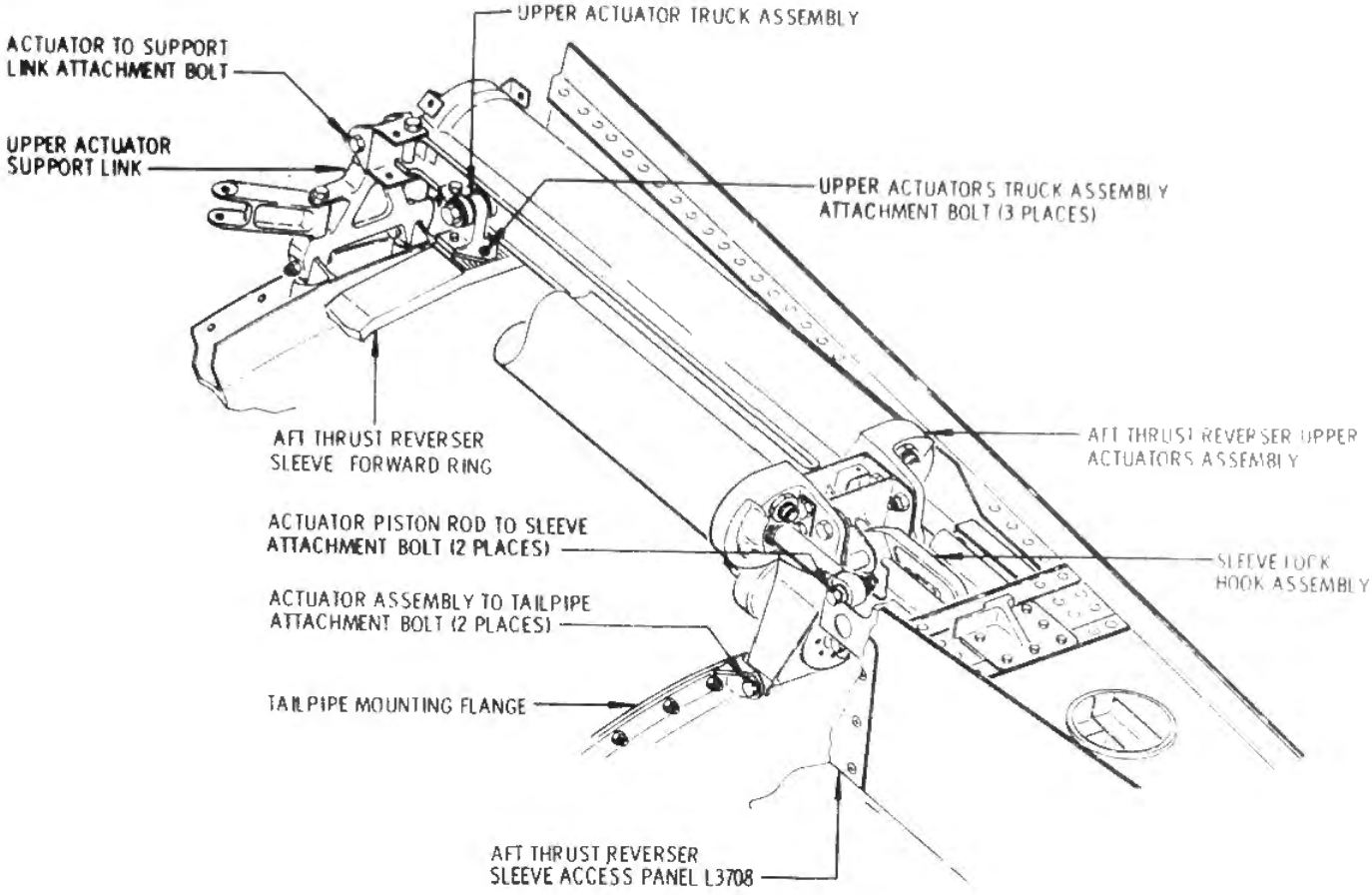


CONFIGURATION 1



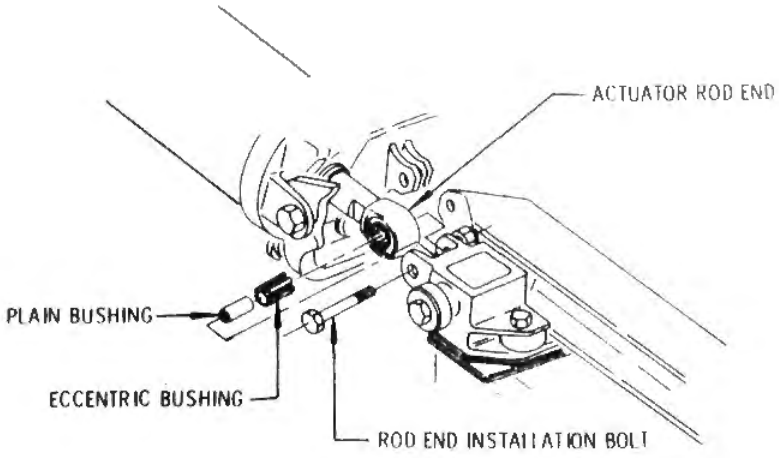
CONFIGURATION 2

A - A



UPPER ACTUATORS INSTALLATION

VIEW 2



DETAIL A

(h) On airplanes having lower actuator support as shown in section A-A, configuration 2, support actuators manually and remove two bolts at lower actuator support plate to free actuator assembly from engine.

(2) Remove aft thrust reverser upper actuator assembly. (See view 2, figure 201.)

(a) Manually position thrust reverser in forward thrust position.

(b) Remove aft thrust reverser sleeve access panels L3708 and R3708 in strut fairing area of sleeve. See Chapter 12, "Access Doors and Panels."

(c) Remove bolt, nut and bushing (2 places), attaching actuator assembly to tailpipe.

(d) Disconnect actuator piston rods from sleeve connection by removing bolt, 2 bushings, washer, nut and cotter pin in two places.

(e) Disengage sleeve locks and manually move sleeve aft to gain access to upper actuator truck attachment bolts.

(f) Remove bolts, washers, serrated splice plate and shims, attaching truck to forward ring.

(g) Remove bolt, nut, and two bushings attaching upper actuator assembly to upper actuator support link and remove upper actuator assembly.

C. Install Aft Thrust Reverser Actuators

(1) Install aft thrust reverser lower actuator assembly.

(a) Position aft thrust reverser lower actuator assembly underneath engine and forward of aft thrust reverser sleeve, as shown in figure 201 and attach eyebolt support strap or actuator support plate with 2 bolts and nuts to mounts on engine flange. Section AA on view 1 calls out the two forward actuator support configurations in use.

(b) While still supporting actuators manually connect actuator support link to thrust reverser assembly forward ring with bolt, nut, bushing and cotter pin (2 places).

(c) Attach support straps to support fitting with bushing, bolt, nut and cotter pin. Install bolt with shank pointing out.

(d) Connect actuator rod ends to lower actuator truck assembly with 2 bushings, bolt, nut and cotter pin.

(e) Connect lower sleeve track to actuators with bolt and nut.

(f) Connect pneumatic tubing. Tighten coupling nut at connection of pneumatic line to welded manifold cross fitting to 350-400 pound-inches torque.

CAUTION: DO NOT EXCEED THIS TORQUE LIMIT ON ANY WELDED FITTINGS ON THE MANIFOLD OR DAMAGE TO THE FITTING MAY RESULT.

(2) Install aft thrust reverser upper actuator assembly. (See view 2, figure 201.)

(a) Slide sleeve forward so that sleeve forward ring is forward of tailpipe mounting flange.

(b) Position actuators from forward end of sleeve. Align upper actuator truck assembly with mounting surface on sleeve forward ring.

(c) Attach sleeve forward ring to upper actuator truck with 3 bolts and washers, serrated splice plate and shims. Position splice plate and shims between truck and upper surface of forward ring. Install bolts from bottom side of rings.

(d) Attach actuators to tailpipe with bolt, nut and bushing (2 places).

(e) Attach actuators to upper actuator support link with bolt, nut and two bushings.

(f) Connect pneumatic tubing.

(g) Connect actuator rod ends to sleeve connection.

1) Gain access to actuator rods and sleeve connection through access panels L3708 and R3708.

2) Position eccentric bushing in rod end so that piston rod is in uppermost position relative to cylinder centerline. (Hole in bushing down.)

3) Position plain bushing in eccentric bushing.

4) Attach rod end with bolt, nut, washer and cotter pin to sleeve connection.

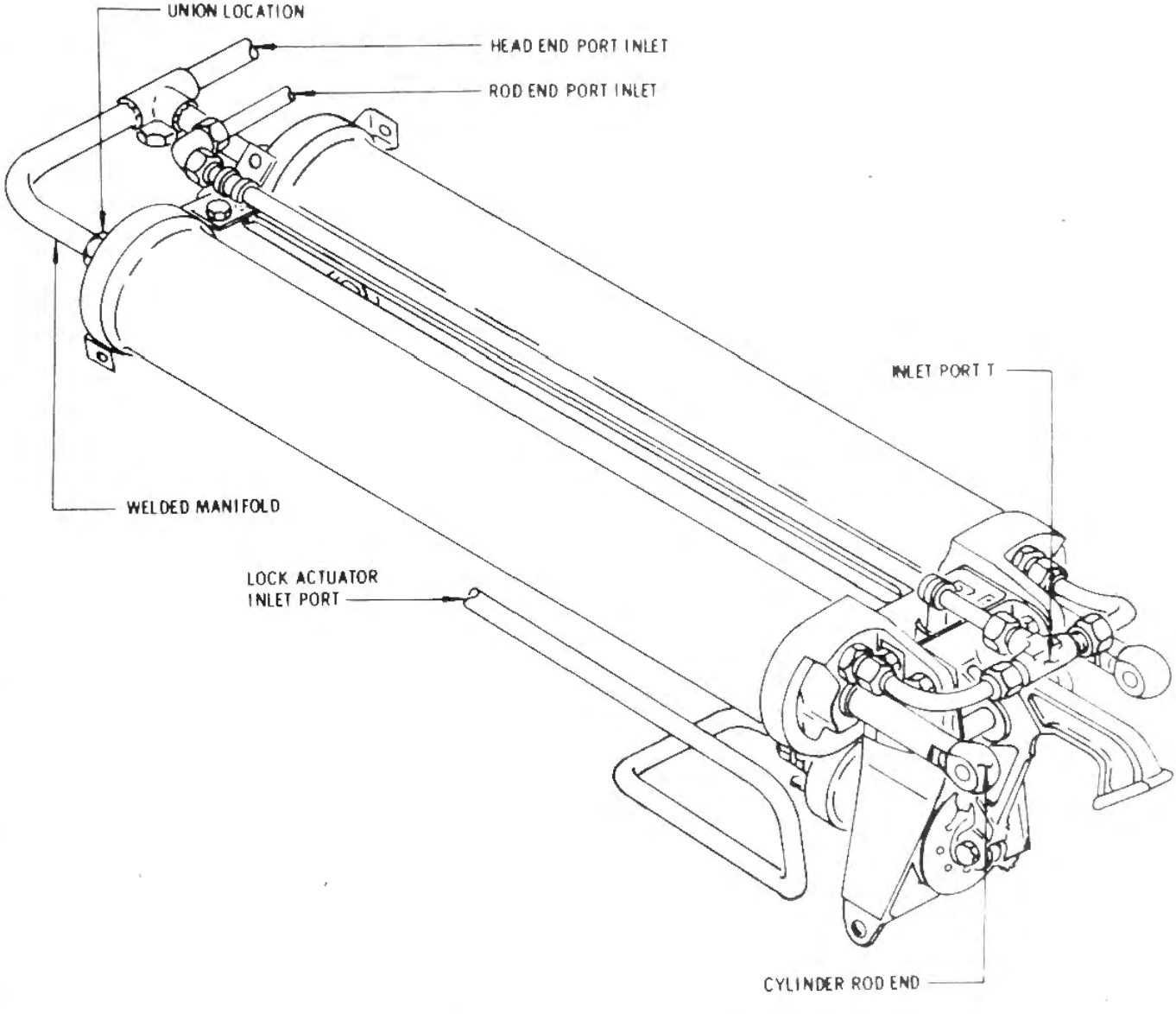
(3) Rig aft thrust reverser. See 78-5-61, "Adjustment/Test Aft Thrust Reverser."

3. Deactivate Aft Thrust Reverser Upper Actuator Cylinder

A. Remove aft thrust reverser sleeve access panels L3708 and R3708.

B. Remove short line at rear of the affected cylinder and cap inlet port tee. (See figure 202.)

C. Disconnect cylinder rod end, push rod to stowed position, and secure with safety wire.



UPPER CYLINDER INSTALLATION

D. Remove welded manifold assembly "B" nuts from the forward end of both cylinders.

NOTE: This is necessary due to the rigidity of the welded manifold and clearance between "B" nut when installing plug.

E. Remove "B" nut union from cylinder to be deactivated and plug "B" nut with suitable plug.

F. Reinstall weld manifold assembly on operative cylinder.

G. Replace access panels.

H. Run aircraft and reverse one complete cycle noting reversing action.

I. Tag all parts and store in airplane cargo compartment.

AFT THRUST REVERSER HINGE DRIVE MECHANISM - MAINTENANCE PRACTICES

1. Removal/Installation Aft Thrust Reverser Hinge Drive Mechanism (Upper or Lower Hinge Area)

A. Equipment and Materials

(1) Antiseize compound - Ease-Off 990 (Texacone Company, Dallas 8, Texas) or equivalent

B. Remove Hinge Drive Mechanism

(1) Disconnect hinge drive mechanism drag links (2, figure 201) from aft thrust reverser sleeve at sleeve connections.

(2) Disconnect hinge drive links (5) from clamshell door hinge arms by removing bolt (6) through clamshell door hinge arm.

(3) Unfasten lock wire and remove idler link installation bolt (7) at hinge support fitting (2 places).

(4) Remove hinge drive idler link (1) with link (5) and link (2) attached (2 places).

C. Install Hinge Drive Mechanism

(1) Coat threads and shank of all bolts with antiseize compound prior to installation.

(2) Place aft thrust reverser in forward thrust position.

(3) Position one hinge drive idler link (1, figure 201) with hinge drive drag link (2) and hinge drive link (5) attached at installation location at clamshell door hinge area and install idler link installation bolt (7) through hinge support fitting and idler link (1). Lockwire bolt.

(4) Connect hinge drive link (5) to clamshell door hinge arm with bolt (6). Insert bolt from outer surface of hinge arm through aft follow-up rod and hinge drive link (5).

(5) With aft thrust reverser sleeve against forward stops insert rigging pins through hinge drive idler links (1) and hinge support fitting, adjust length of hinge drive mechanism drag links (1) so that installation bolt (4) can be inserted freely through sleeve attachment and rod end.

(6) Install nut and cotter pin.

2. Adjustment/Test Hinge Drive Mechanism

A. Adjust Hinge Drive Mechanism (See figure 201.)

(1) Manually position aft thrust reverser sleeve against forward stops.

(2) Remove side cowl panels.

(3) Adjust length of hinge drive drag link rods by using check nut at aft thrust reverser sleeve connection end until rigging pins can be easily inserted through the rigging pin holes through the hinge drive idler links (1) and the hinge support fitting.

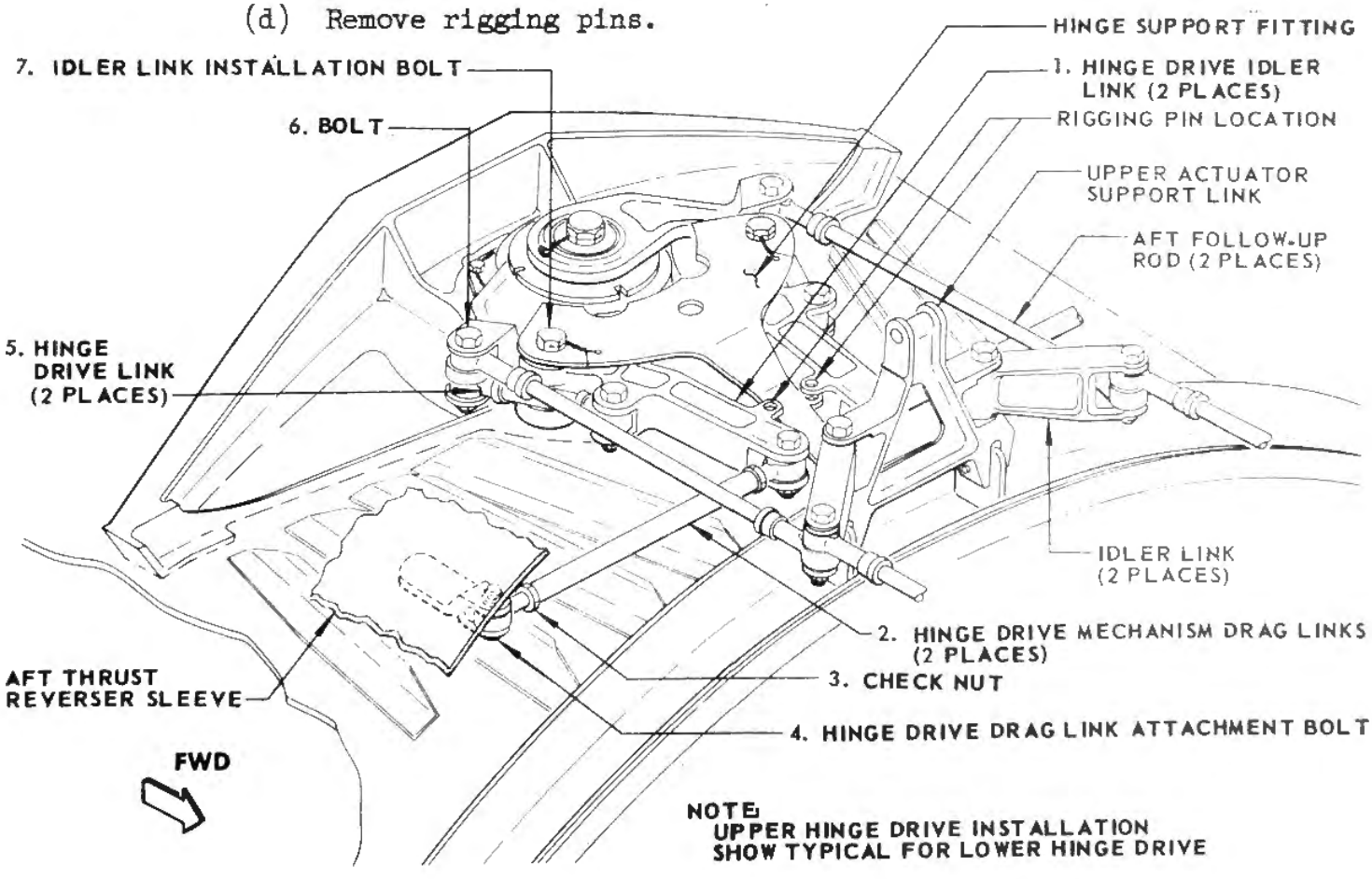
(4) Adjust length of hinge drive drag links (2) using check nuts at sleeve connection end of drag link rods.

(a) Disconnect hinge drive mechanism drag links (2) by removing bolt (4), nut and cotter pin (2 places).

(b) Align rigging pin holes in hinge drive idler links (1) and hinge support fitting and insert rigging pins.

(c) Adjust length of drag links (2) using check nut (3) at sleeve connection until attachment bolt (4) can be freely installed.

(d) Remove rigging pins.



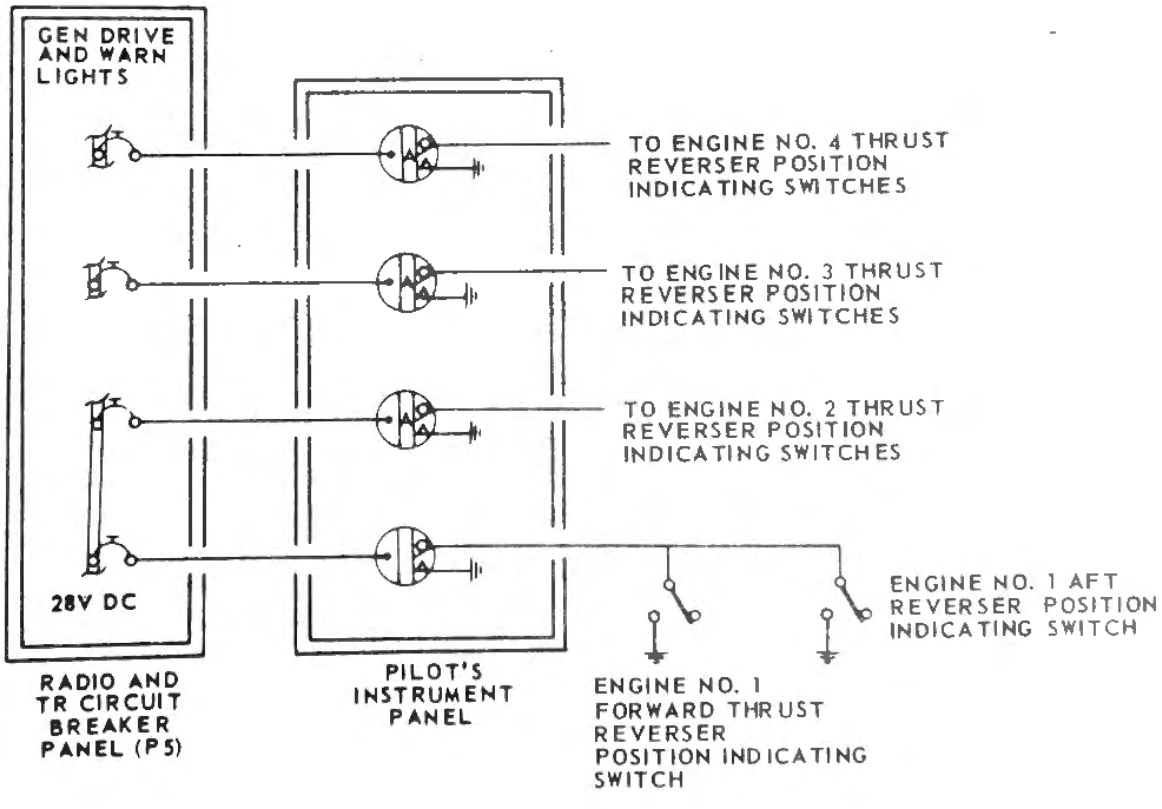
Hinge Drive Mechanism Installation
Figure 201

THRUST REVERSER POSITION INDICATING SYSTEM - DESCRIPTION AND OPERATION

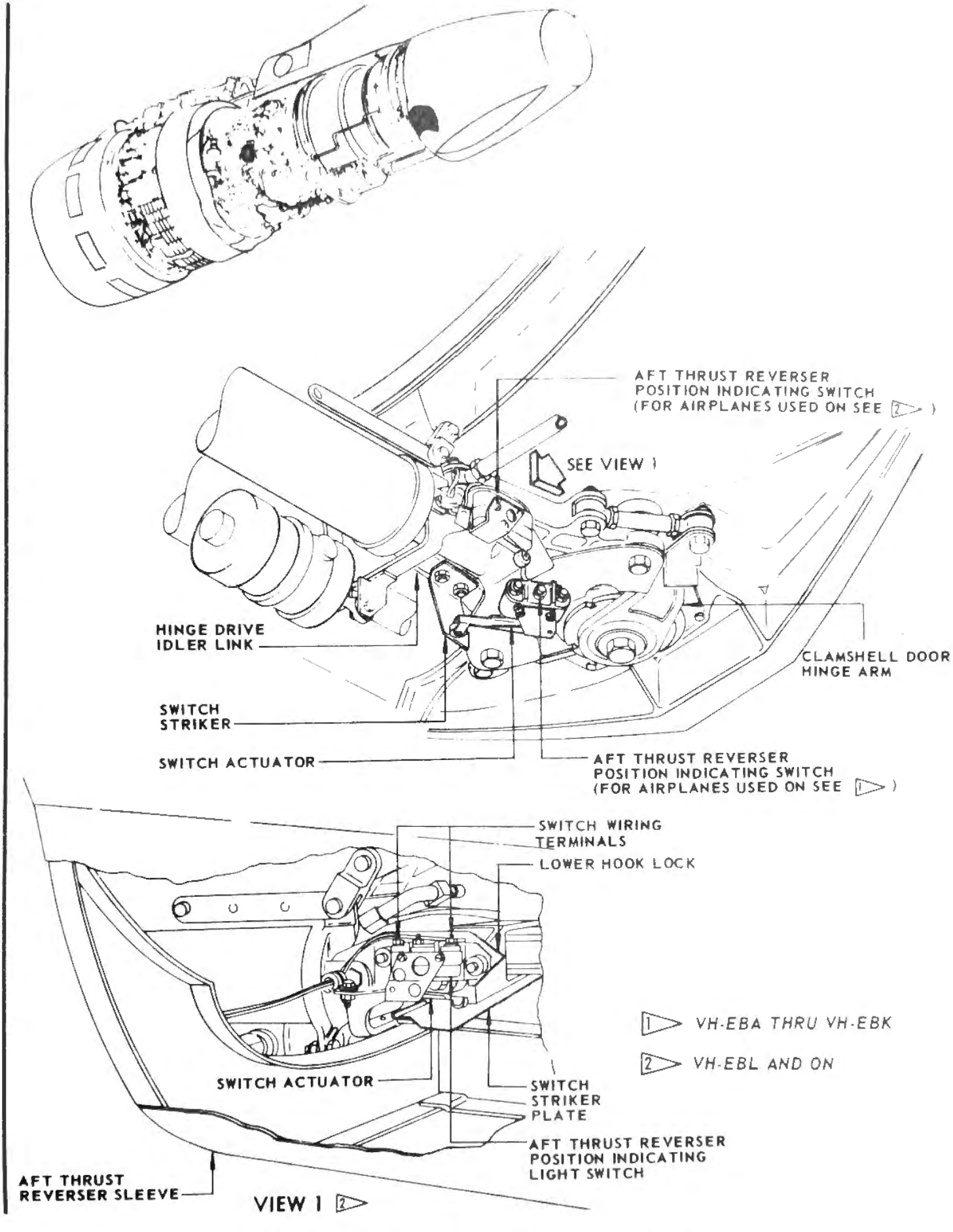
1. General

A. A position indicating system for each thrust reverser provides an amber light indication (to the pilot) of the position of the forward and aft thrust reversers relative to their forward stowed position and, on later airplanes, provides indication of whether or not the aft thrust reverser is locked. Illumination of a light indicates that either the forward thrust reverser sleeve or the aft thrust reverser sleeve has left the forward stowed position or that both sleeves have left the forward stowed position. On later airplanes, the light will illuminate whenever the aft thrust reverser sleeve mechanical lock is disengaged.

B. The position indicating system consists of two microswitches on each engine, one for the forward thrust reverser and one for the aft thrust reverser, and an amber position indicating light for each engine. (See figure 1.) The system utilizes 28 volt d-c power. The microswitch for the aft thrust reverser on airplanes VH-EBA thru VH-EBK is mounted underneath the aft thrust reverser below the clamshell door hinge drive mechanism just forward of the lower door hinge centerline. (See figure 2.) The switch actuator contacts a metal striker plate attached to the

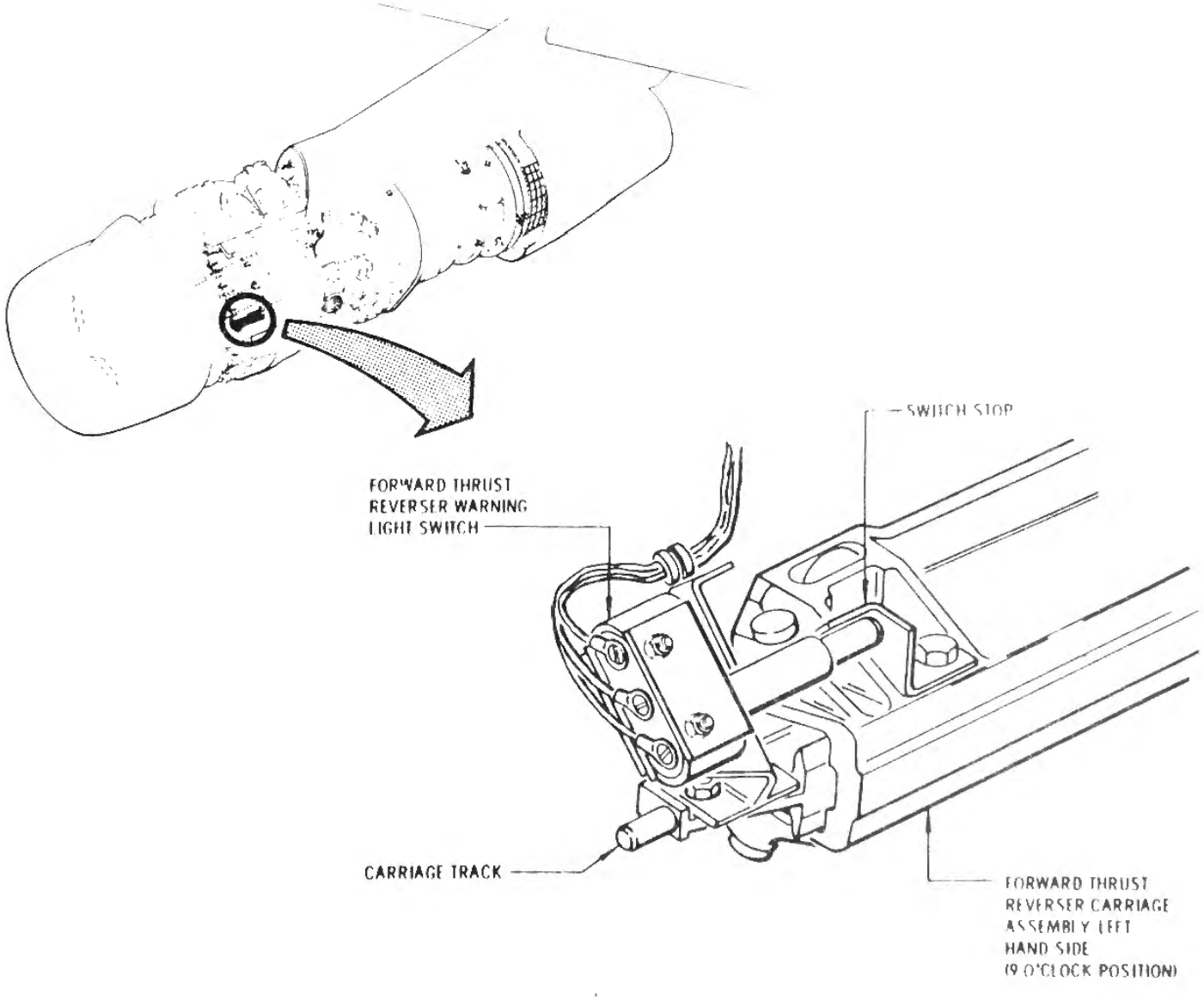


Thrust Reverser Position Indicating System Circuit
Figure 1



Aft Thrust Reverser Warning Light Switch
Figure 2

lower right hinge drive idler link to maintain the switch plunger in the depressed position (position indicating light off) during forward thrust operation. The microswitch for the aft thrust reverser on airplanes VH-EBL and on, is mounted to the left-hand side of the lower hook lock. The switch actuator contacts a metal plate mounted to the undersurface of the thrust reverser lower truck to maintain the switch plunger in the depressed position (position indicating light off) when the aft thrust reverser sleeve is in the forward stowed position and the hook lock is engaged. Whenever either the hook lock is disengaged or the sleeve is out of the forward stowed condition or both, the position indicating light will illuminate. The forward thrust reverser microswitch is attached to the forward thrust reverser carriage assembly at the 9:00 o'clock position as shown in figure 3. A striker plate, mounted on the carriage, holds the switch plunger in the depressed position (position indicating light off) during forward thrust operation.



Forward Thrust Reverser Warning Light Switch
Figure 3

WARNING LIGHT SWITCHES - MAINTENANCE PRACTICES

1. Adjustment/Test Thrust Reverser Warning Light Switches

A. General

(1) The thrust reverser warning light switches may be tested by observing the warning lights while operating the thrust reverser with ground air. Caution must be exercised when operating the system with an external air source to avoid violent operating speeds.

WARNING: PERSONNEL MUST STAY CLEAR OF ENGINE WHEN THRUST REVERSER IS BEING ACTUATED. A PLACARD SHOULD BE PLACED ON CONTROL STAND WARNING AGAINST ACTUATION OF THRUST LEVERS WHILE PERSONNEL ARE WORKING ON THRUST REVERSER.

B. Equipment and Materials

(1) Air pressure source - 60 psig capacity

C. Adjust Aft Thrust Reverser Warning Light Switch (Applicable to VH-EBL and on)

(1) Remove engine side cowl panels.

(2) With aft thrust reverser in forward thrust position and rigging pin holes in idler links and hinge support fitting lined up, adjust switch so that it is actuated (position indicating light illuminates) when lock hook is moved upward 0.10 (+0.10/-0.00) inch from the fully locked position, as shown in figure 201. Adjust switch to attain this requirement by bending the switch actuator arm slightly.

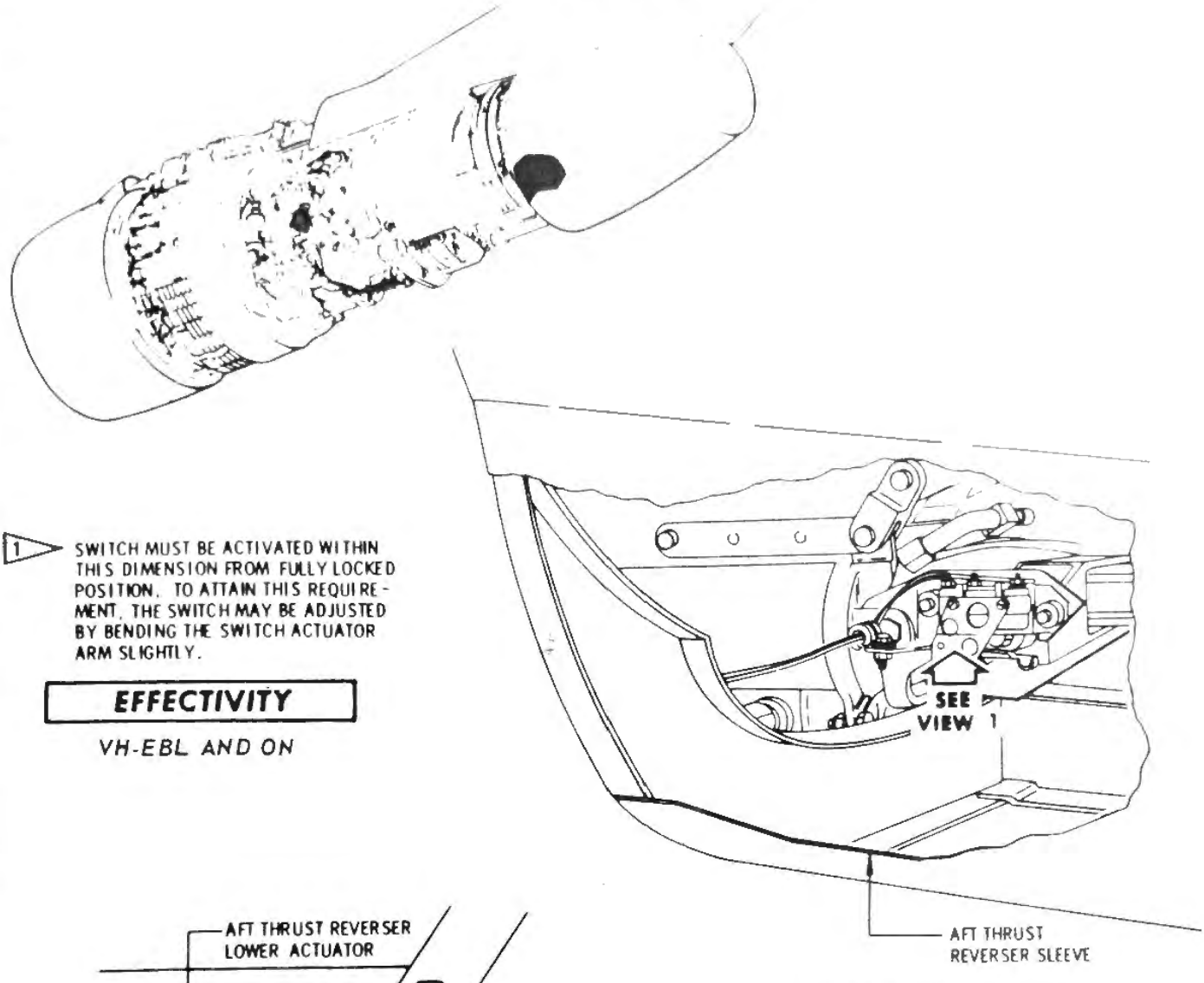
D. Test Aft Thrust Reverser Warning Light Switch

(1) Remove engine side cowl panels and fan cowl panels.

WARNING: GROUND AIR SUPPLY MUST NOT BE CONNECTED UNLESS THE ENGINE SIDE COWL PANELS ARE REMOVED OR COMPLETELY CLOSED AND FAN COWL PANELS REMOVED, TO AVOID STRUCTURAL OR ENGINE DAMAGE OR INJURY TO PERSONNEL.

(2) Disconnect electrical leads from forward thrust reverser position indicating switch.

NOTE: This is necessary because either (forward or aft) of the position indicating switches, when actuated, cause the position indicating light to illuminate.



1 SWITCH MUST BE ACTIVATED WITHIN THIS DIMENSION FROM FULLY LOCKED POSITION. TO ATTAIN THIS REQUIREMENT, THE SWITCH MAY BE ADJUSTED BY BENDING THE SWITCH ACTUATOR ARM SLIGHTLY.

EFFECTIVITY

VH-EBL AND ON

Aft Thrust Reverser Position Indicating Switch Adjustment
Figure 201

(3) Connect electrical power to warning light circuit.

(4) Place forward and reverse thrust levers at idle.

(5) Connect air pressure source to ground service connection in nacelle strut, and regulate to 25 psig to hold thrust reverser in forward thrust position. See figure 6, 78-6-0, for location of ground service connection.

(6) Check that applicable aft thrust reverser warning light switch on pilot's instrument panel is not illuminated.

(7) On airplanes VH-EBA thru VH-EBK move reverse thrust lever aft to interlock position (approximately 60° of lever movement). The applicable aft thrust reverser warning light should illuminate immediately after the aft thrust reverser sleeve has left the forward sealed position. Open the circuit breaker. The light shall go off. Close the circuit breaker.

(8) On airplanes VH-EBL and on push aft end of lock hook upwards 0.10 (+0.10/-0.00) as shown in figure 201 and check that position indicating light illuminates.

(9) Move lever to maximum reverse thrust position and return to interlock position. Check that warning light remains illuminated during entire cycle.

(10) Return reverse thrust lever to "IDLE" position. Check that warning light is off.

(11) Disconnect air source and electrical power.

(12) Reconnect wiring to forward thrust reverser warning light switch.

(13) Replace side cowl panels and fan cowl panels.

E. Test Forward Thrust Reverser Warning Light Switch

(1) Remove engine side cowl panels and fan cowl panels.

WARNING: GROUND AIR SUPPLY MUST NOT BE CONNECTED UNLESS THE ENGINE SIDE COWL PANELS ARE REMOVED OR COMPLETELY CLOSED AND FAN COWL PANELS REMOVED, TO AVOID STRUCTURAL OR ENGINE DAMAGE, OR INJURY TO PERSONNEL.

(2) Disconnect electrical leads from aft reverser warning light switch.

NOTE: This necessary because either of the warning light switches, forward thrust reverser or aft thrust reverser, when actuated, cause the warning light to illuminate. (See 78-7-0, figure 1.)

(3) Connect electrical power to warning light circuit.

(4) Place forward and reverse thrust levers at idle.

(5) Connect air pressure source to ground service connection in nacelle strut and regulate to 25 psig to hold thrust reverser in forward thrust position. See figure 6, 78-6-0, for location of ground service connection.

(6) Check that applicable warning light switch is not illuminated.

(7) Move reverse thrust lever aft to interlock position (approximately 60° of lever movement). The applicable warning light should illuminate immediately after the cowl ring assembly has left the forward sealed position. Open the circuit breaker. The light shall go off. Close the circuit breaker.

(8) Move lever to maximum reverse thrust position and return to interlock position. Check that warning light remains illuminated during entire cycle.

(9) Return reverse thrust lever to forward thrust "IDLE" position. Check that warning light is off.

(10) Disconnect air source and electrical power.

(11) Reconnect wiring to aft thrust reverser warning light switch.

(12) Replace engine side cowl panels and fan cowl panels.